

MOSS FLORA

OF

NORTH AMERICA

North of Mexico

BY

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POLYTRICHACEAE

BY

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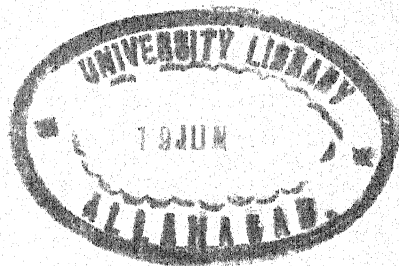
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CALYMPERACEAE

BY

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2. ANGSTROEMIA Bry. Eur. fasc. 33-36. 1846.

Plants with the habit of an *Anomobryum* but the peristome of a *Dicranum*. We have only the type species, *A. longipes*.

ANGSTROEMIA LONGIPES (Sommerf.) Bry. Eur. l. c.

Weisia longipes Sommerf. Suppl. Fl. Lapp. 52. 1826.

Dicranum julaceum Hook. in Drumm. Musc. Am. 100. 1828.

Plants gregarious or in loose thin mats; stems filiform, julaceous, small, mostly 5 mm. or less in height, rarely up to 1 cm., bearing single branches from just below the perigonal or perichaetial leaves; lower stem leaves minute, scale-like, appressed, ovate, rather obtuse, 0.5-1 mm. long, upper and perichaetial leaves much larger, ovate-lanceolate and the latter acuminate, about 1.5 mm. long, entire or nearly so; costa strong, vanishing a little below the apex, flattened, with a small stereid band; leaf cells very smooth, rather irregular, above elongated-hexagonal and rhomboidal, below oblong-rectangular, median 8-15 x 30-60 μ , narrower at the margin, linear in acumination. Dioicous; male flowers terminal and conspicuous; seta 4-12 mm. long, smooth; capsule ovoid, erect and symmetric, about 0.6-1 mm. long, apparently without stomata; operculum long-conic to short-rostrate; annulus lacking; peristome teeth reddish, entire, perforate, or rarely divided nearly $\frac{1}{2}$ the way down, more or less striate longitudinally; spores nearly smooth, up to 22 μ ; mature in summer. Type locality, Lapland.

ILLUSTRATIONS:—Bry. Eur. pl. 94; Limpr. Laubm. 1: 303. f. III; Pl. 39.

EXSICCATI:—Drumm. l. c.; Macoun, Can. Musci 11a, 25.

On moist banks; Greenland; Alaska to British Columbia; rare.

3. RHABDOWEISIA Bry. Eur. fasc. 33-36. 1846.

Plant small, up to 3 cm. high, usually much less, in dense tufts or cushions; stems without central strand, densely foliate, radiculose at base and more or less branched above; leaves linear-lanceolate, acute, more or less crisped when dry, spreading-flexuous when moist, plane-margined, nearly or quite smooth; costa stout, ending just below the apex, in cross section with a band of guide cells having a strong stereid band below and none or a very faint one above; lamina cells short, subquadrate and rounded above; basal more elongated, rectangular and paler, with alar cells not differentiated. Autoicous; σ buds mostly on short stalks just below the perichaetium; seta erect, 2-5 mm. long; capsule exserted, erect, symmetric, less than 1 mm. long, ovoid to short-oblong, deeply 8-plicate when dry and empty, with a few stomata at base; calyptra cucullate, smooth, not fringed at base; operculum with a long oblique beak; annulus lacking; peristome teeth narrow, often filiform above, without median line, smooth to faintly papillose or striate.

Type species: *R. fugax*.

KEY.

Leaves serrulate above; peristome teeth wider, tapering gradually from a broader base... 1. *denticulata*.
Leaves nearly or quite entire; peristome teeth abruptly filiform from a short wide base... 2. *fugax*.

RHABDOWEISIA DENTICULATA (Brid.) Bry. Eur. fasc. 33-36. pl. 42. 1846.

Weisia denticulata Brid. Musc. Recent. Suppl. 1: 108. 1806.

Rhabdoweisia crispata (Dicks.) Kindb. Eur. & N. Am. Bryin. 211. 1897.

Plants light- to dark-green in short dense sods; stems mostly less than 1 cm. long; leaves oblong- to linear-lanceolate, smaller below, above longer, up to 2-3 mm. and rather crowded, typically closely and finely serrulate above, but often with the teeth few and distant, keeled above, narrowly to broadly acute; costa not quite percurrent, nearly or quite smooth on the back; upper leaf cells mostly rounded-quadrate, in 7-11 rows in the upper middle of the leaf, 8-17 μ in width, larger near the costa, smaller and sometimes transversely elongated at the margins, smooth or somewhat bulging; basal cells much larger, thinner-walled and hyaline, rectangular, extending up to about $\frac{1}{4}$ of the leaf along the costa but not so far along the margin. Seta erect, 2-5 mm. long; capsule ovoid, urn 0.5-1 mm. long, operculum somewhat shorter; peristome teeth linear from a lanceolate base, smooth to slightly striate and papillose; spores about 17 μ , slightly roughened, mature in summer. Type locality, England.

ILLUSTRATIONS:—Bry. Eur. 1: c.; Limpr. Laubm. 1: f. 103; Braithw. Brit. Moss Fl. 1: pl. 26B; Pl. 39.

EXSICCATI:—Drumm. Musc. Am. 68 (as *Weisia striata*); Holz. Musc. Acro. Bor. Am. 78 (as *R. fugax*); Grout, Musci Perf. 10.

Clefts of ledges in cool moist shaded elevated regions; Newfoundland to Alaska; south to N. Carolina, Tennessee, Missouri and Manitoba.

Williams seems to be correct in thinking that we do not have true *R. fugax* (Hedw.) Bry. Eur. north of Mexico, but the leaves of much of our material are intermediate. For these forms I have adopted Dr. Culman's manuscript name given in a letter to Holzinger about his 446. True *fugax* has the leaves narrower at the apex, with fewer rows of cells at the middle, margins entire or nearly so, upper cells more rounded and with thicker walls and the peristome teeth are *abruptly filiform from a broader base*, not tapering as in *denticulata*. Pl. 40.

Most of our plants average narrower and less serrate leaves than the European and I have seen no American plants with leaves as broad (15 rows of cells) or so strongly serrate as Husnot's Musc. Gall. 401, and I have seen no European plants to match the narrow, nearly entire leaves of Austin's 71 or Holzinger's 446, but some American plants almost exactly match some European and the peristomes of all seem to be the same.

Var. AMERICANA Culman Ms. n. var.

Leaves narrowly acute and sometimes almost entire. Pl. 48.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 446 (type); Austin Musc. Appal. 72 & 71 (as *R. fugax*). Also W. Virginia (Ammons).

With the range of the species east of the Mississippi. The North American plants of our range referred to *R. fugax* are almost wholly this variety.

4. OREOWEISIA DeNot. Atti Univ. Genova 1: 489. 1869.

Small tufted rock-growing mosses, rarely, if ever, found except where lime is present. Differing from *Dichodontium* chiefly (in our species) in having the peristome teeth mostly undivided and without median line. Type species, *O. serrulata*.

OREOWEISIA SERRULATA (Funck) DeNot. 1. c.

Weisia serrulata Funck; Brid. Bryol. Univ. 1: 804. 1827.

Oreoweisia serrulata var. *tenuior* Kindb.; Macoun, Cat. Can. Pl. 6: 15. 1892.

Oreoweisia obtusata Kindb. Rev. Bryol. 23: 18. 1896.

Plants in compact tufts, light to dark green above, often compacted with soil below; stems 1–5 cm. long, slender, little branched, with radicles more or less papillose; leaves lanceolate to narrowly oblong, from an erect subclasping base widely spreading to squarrose when moist, when dry incurved-crisped, acute to obtuse, in our sterile plants seldom over 1 mm. long, usually less (according to Williams and Brotherus reaching 2.5 mm.), deeply keeled; margins plane above, more or less recurved in the middle, finely and rather closely and evenly serrulate by projecting cells, with these teeth larger at the apex; costa strong, papillose on the back, ending a few cells below the apex, in cross section near the middle showing 2–4 median guide cells *with stereid bundles on the lower side only*, with only the large outer cells on the upper surface and differentiated papillose cells at the back; upper leaf cells obscure, pointed-mamillose on both sides, roundish to nearly square, arranged in longitudinal rows, about 12 μ wide; basal cells larger, rectangular and smooth, quadrate along the basal margin; alar not differentiated; perichaetial leaves little different. Autoicous; seta erect, about 5 mm. long; capsule oblong, erect and symmetric or nearly so, up to 1.2 mm. long, neck short and inconspicuous; operculum long-conic to short-rostrate; calyptra cucullate, relatively large, smooth above, not fringed at base; annulus lacking; peristome teeth slender, separate nearly to the capsule mouth, mostly undivided and without median line, articulate, nearly smooth; spores 18–24 μ in diameter, rough, mature in September. Type locality, Switzerland.

ILLUSTRATIONS:—Bry. Eur. pl. 27; Limpr. Laubm. 1: 296. f. 108; Pl. 40.

EXSICCATI:—Aust. Musc. Appal. 70.

On moist shaded ledges in cool or elevated regions; rare and found fruiting in N. America in Alaska only. Southern Vermont, Ontario, Minnesota, Wyoming, British Columbia and Alaska; south to New Jersey, Tennessee and Kentucky; abundant in Palenville Cove, Catskill Mts., N. Y.

Often confused with *Dichodontium pellucidum*, for distinctions see under that species. European plants apparently have larger leaves and more strongly papillose radicles.

5. DICHODONTIUM Schimp. Coroll. 12. 1855.

Plants in yellowish to dark-green cushions, compact to loosely tufted, usually growing in moist places by rocky streams; stems with a central strand, radiculose in the older parts with *smooth* radicles; stem leaves contorted to crisped when dry, oblong or ovate to linear-oblong; costa strong, not quite reaching the apex, in cross section with stereid bands above and below the guide cells; upper leaf cells nearly square or rounded-quadrate, papillose-mamillose with a large papilla on each surface, obscure; basal cells larger, more elongated, smooth and clearer; alar not differentiated. Dioicous; capsule long-exserted on a long smooth seta but often overtopped by innovations; capsule oblong to ovoid, symmetric or slightly curved, erect or inclined; operculum conic-rostrate; annulus wanting; peristome dicranoid; calyptra cucullate, entire at base, often somewhat rough above. Type species, *D. pellucidum*.

1. DICHODONTIUM PELLUCIDUM (L., Hedw.) Schimp. 1. c.

Dicranum pellucidum Hedw. Sp. Musc. 142. 1801.

Dichodontium flavescens (Dicks.) Lindb. Bot. Not. 1878: 113. 1878.

Dichodontium subflavescens Kindb.; Röhl, Hedwigia 35: 59. 1896.

Plants in small tufts to large sods, yellowish- to dark-green, brown below, radiculose to near the new growth, often bearing in the leaf axils globular stalked brood-bodies or protonema-like filaments (see Correns, Untersuchungen, figs. 1 & 2); stems slender, 1-10 cm. long, little branched, but often with slender subapical innovations; leaves ovate-lanceolate to lingulate with a broad clasping base or narrowly oblong-lanceolate, acute to narrowly obtuse, nearly entire or finely and evenly serrulate by projecting cells or even coarsely and irregularly serrate above, 1-5 mm. long; when dry usually somewhat incurved and variously contorted and twisted; when moist widely spreading to squarrose; margin recurved below, often somewhat undulate above; costa stout, ending below the apex, rough on the back above, in cross section near the middle showing about 4 guide cells *with stereid bands above and below* and much larger outer cells; upper leaf cells irregularly quadratic, obscure (or nearly pellucid in forms), 8-12 μ in diameter, conic-mamillose on both sides, these quadrate cells *running in several rows down the margins nearly to the insertion*; median basal cells rectangular, reaching 1:4, smooth, rather pellucid; alar cells not differentiated; perichaetial leaves little different except without quadrate marginal cells at base, longer and often broader at base. Dioicous; seta erect, 1-2 cm. long, yellowish; capsule oblong to ovoid, nearly erect and symmetric to curved and inclined, 1.5 mm. or more in length, more or less contracted under the mouth when dry, smooth; operculum conic-rostrate, sometimes nearly as long as the urn; peristome teeth dark-reddish, divided mostly into two prongs about half way down, more or less striate below the forks and papillose above, sometimes without these markings; basilar membrane extending 2-3 rows of cells above the capsule mouth; spores slightly rough, 14-20 μ in diameter, mature late autumn to early spring. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. pl. 50, 51; Limpr. Laubm. 1: 299. f. 109, 110; Braithw. Brit. Moss. Fl. pl. 24D; Pl. 40.

EXSICCATI:—Drumm. Musc. Am. 108; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 60, as var. *americanum*; Aust. Musc. Appal. 76; R. & C. Musc. Am. Sept. 355; Holz. Musc. Acro. Bor. Am. 585, 586, 609, 438 (as *Oreoweisia serrulata*); Allen, Mosses Cascade Mts. 13, 14; Macoun, Can. Musci 402, 451; Grout, Musci Perf. 110, as var. *serratum*.

Found along rocky streams in cool moist places, sometimes in water, often where lime is present; Labrador to Alaska, south to New Jersey, Pennsylvania, Great Lakes region, Idaho, Montana, and California.

Fruiting rather infrequently and in the western part of its range only.

This species varies greatly in almost all parts of the plant, but these variations do not seem to be correlated in any manner sufficient to define varieties even. Mr. H. N. Dixon (Rev. Bryol. 30: 39-43. 1903) has noted the most important of these variations as follows:

Plants green or yellowish; plants short, slender, *or* tall and robust; leaves closely set, shortly oblong-lingulate, when dry curled and incurved closely towards the stem, *or* leaves looser, much longer, linear-lanceolate from a distinct base, tapering, when dry flexuose or twisted but still spreading, not incurved; margin entire, crenulate, *or* serrulate towards apex, *or* leaves often strongly serrulate to the middle of the leaf or below; upper cells obscure with strong papillae, *or* upper cells pellucid, lightly papillose to nearly smooth; basal cells with several marginal rows of quadrate ones reaching to the base, *or* only one or two rows of quadrate cells to base; capsule ovoid, inclined, slightly curved and gibbous, *or* capsule oblong to

subcylindric, erect and symmetric; dorsal surface of purple-red regular peristome teeth covered to near apex with vertical striae, with basal membrane of 4-8 articulations, *or* orange-red more irregular teeth without vertical striae, coarsely papillose above, with basal membrane of 2-3 articulations. Plants having the first set of characters would be ideal *D. pellucidum* and those having the second set, ideal *D. flavescens* but such plants do not occur. Plants with strongly serrate leaves are the var. *serrulatum* Schimp., Musci Perfecti 110, is a good example. Several other varieties have been described but their characters have been included in the above descriptions.

D. pellucidum and *Oreoweisia serrulata* are not infrequently confused as in the case of Holzingers 438. The following are the most obvious distinctions; *Oreoweisia* has the larger radicles more or less papillose, no brood bodies, basal marginal cells shorter but much less distinct from the median basal, cross section of costa with no stereid band above the guide cells; peristome teeth without median line, only occasionally divided. *D. pellucidum* has non-papillose radicles, brood bodies frequently present in leaf axils, marginal basal cells as described above, median cross section of costa with stereid bands above and below guide cells (but not always in other sections). Peristome teeth without median line, mostly undivided.

Very slender forms like Holzinger's 586 & 509 closely resemble *Dicranella* in macroscopic appearance. 509 with its short, relatively broad leaves seems correctly referred to var. *fagimontanum* (Brid.) Schimp. and is strikingly different from the general run of specimens.

The capsules of var. *americanum* (Lesq. & James, Man. 62) from Brattleboro, Vt. (Frost) are very slightly strumose as are some of Allen's 14.

2. DICHODONTIUM OLYMPICUM R. & C. Rev. Bryol. 19: 74. 1892.

Plants in compact dark green cushions, scarcely 1 cm. high; leaves less than 2 mm. long, contorted-appressed when dry, when moist spreading to recurved, oblong-lanceolate to almost lingulate, rounded-obtuse to obtusely acute; margins plane, not serrate but papillose-crenulate, more strongly so near the base; costa rough with finer sharp papillae almost to the insertion; upper leaf cells obscure, about 7 μ in width, papillose with fine sharp papillae, which are sometimes forked; capsule slightly strumose; peristome teeth more or less longitudinally striate below. Type locality, Olympic Mts., Washington (Henderson).

ILLUSTRATIONS:—Bot. Gaz. 30: pl. 2, f. 1; Pl. 41 & 48.

On bluffs near the snow line; known from the type locality only. Type collection seen through the courtesy of the N. Y. Botanical Garden and R. S. Williams.

The plane margins, sharper papillae and strumose capsule seem to characterize this form sufficiently for specific rank.

6. ONCOPHORUS Brid. Bryol. Univ. 389. 1826.

Cynodontium Schimp. Coroll. Bry. Eur. 12. 1855. Not of Brid. 1806.

Plants of small or medium size, growing in compact tufts or more extensive sods, bright to yellowish green; leaves mostly crisped when dry, not falcate-secund, when moist erect-spreading to squarrose, narrowly to broadly lanceolate, smooth to highly papillose or mamilllose; margins entire or serrate, usually of two layers of cells, and more or less recurved (except in *O. Wahlenbergii*); costa from nearly percurrent to excurrent, in cross section with guide cells and more or less developed stereid bands above and below (except *O. strumulosum*); upper median leaf cells small, rounded-quadrate to irregular, often obscure; cells in lower part of leaf elongated, rectangular, mostly hyaline and without pitted walls; alar cells often somewhat differentiated in *virens* and *polycarpus*, but scarcely so in the other species. Autoicous; ♂ buds below perichaetium; seta long exerted, straight or curved; capsule erect and symmetric to curved and horizontal, smooth or striate when dry and empty, sometimes strumose; stomata mostly in one row at base of spore sac; peristome teeth 16, mostly divided at least half way down into two papillose forks and longitudinally striate on the outer side (merely perforate in *O. Schisti*); operculum beaked; spores rough. Type species, *O. polycarpus*.

KEY.

- | | |
|---|-----------------------|
| 1. Leaves strongly papillose above (<i>tenellus</i> may be sought here)..... | 2. |
| Leaves faintly or not at all papillose..... | 7. |
| 2. Leaves 1.5 mm. long or less, rounded-obtuse (doubtfully N. American)..... | 6. <i>alpestris</i> . |
| Upper leaves reaching 2 mm. or more in length, if shorter acute..... | 3. |

- | | |
|---|-------------------------------|
| 3. Border of leaf of a single layer of cells..... | 6. |
| Border of a double layer of cells..... | 4. |
| 4. Capsules strumose..... | 1a. var. <i>strumiferus</i> . |
| Capsules not strumose..... | 5. |
| 5. Peristome teeth not divided, sometimes perforate..... | 7. <i>Schisti</i> . |
| Peristome teeth forked, divided at least $\frac{1}{2}$ the way down..... | 1. <i>polycarpus</i> . |
| 6. Upper leaf cells obscure, mostly 6-8 μ wide..... | 4. <i>gracilescens</i> . |
| Upper leaf cells distinct, mostly 9-15 μ wide..... | 5. <i>strumulosus</i> . |
| 7. Capsules not strumose..... | 8. |
| Capsules strumose..... | 10. |
| 8. Annulus large, dehiscent..... | 9. |
| Annulus lacking or narrow and persistent..... | 3. <i>tenellus</i> . |
| 9. Leaf cells 12-20 μ wide, absolutely smooth..... | 2. <i>Jenneri</i> . |
| Leaf cells mostly less than 12 μ wide, more or less papillose..... | 1. <i>polycarpus</i> . |
| 10. Leaf base ovate; alar cells usually quite distinct; leaf margin mostly of 2 layers of cells and recurved..... | 8. <i>virens</i> . |
| Leaf base obovate; alar cells usually not distinct; leaf margin often not recurved..... | 11. |
| 11. Plants light-green, usually on decayed wood; upper lamina of leaf unistratose... | 9. <i>Wahlenbergii</i> . |
| Plants fulvous, usually on rocks; upper leaf lamina bistratose..... | 10. <i>Rauai</i> . |

1. ONCOPHORUS POLYCARPUS (Hedw.) Brid. Bryol. Univ. 1: 397. 1826.

Fissidens polycarpus Hedw. Sp. Musc. 159. 1801.

Dicranum polycarpum Bry. Eur. fasc. 37-40. pl. 47. 1847.

Cynodontium polycarpon Schimp. Coroll. Bry. Eur. 12. 1855.

Plants in compact soft green sods, tomentose within, stems reaching 5 cm. long, mostly shorter, branching; leaves crisped when dry, spreading when moist, rarely reaching 5 mm. long, lanceolate to ovate-lanceolate, acute, keeled above; margins mostly bistratose, more or less recurved, irregularly serrate above, somewhat wavy; costa nearly percurrent to excurrent, often rough on the back above; upper leaf cells rounded-quadrate or irregular, 8-12 μ wide, more or less papillose on both sides; lower cells more elongated, rectangular, paler, smooth; alar cells rarely noticeably differentiated, sometimes wider; perichaetial leaves sheathing $\frac{1}{2}$ the way up. Autoicous; seta yellowish, 8-10 mm. long, straight and erect; capsule erect or slightly inclined, oblong-cylindric, when dry and empty plainly ribbed and somewhat contracted under the mouth; annulus large; operculum irregularly crenulate around the base, with a slender oblique beak nearly $\frac{1}{2}$ as long as the capsule; peristome teeth reddish, divided to below the middle, longitudinally striate below, papillose at apex; spores rough, 20-24 μ in diameter, mature in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. pl. 47; Braithw. Brit. Moss Fl. 1: pl. 25E; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 9M; Limpr. Laubm. 1: f. 106; Pl. 42.

EXSICCATI:—Drumm. Musc. Am. 107; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 45, (Ed. 2) 58. Crevices in mountain ledges, rare; Greenland to Alaska, south to Lake Superior and Montana.

1a. Var. STRUMIFERUS (DeNot.) n. comb.

Fissidens strumifer Hedw. Sp. Musc. 160. 1801.

Dicranum polycarpum var. *strumiferum* DeNot. Syll. 210. 1838.

Leaves usually more strongly papillose on both sides. Capsule inclined and more or less arcuate, distinctly strumose. Pl. 42.

ILLUSTRATIONS:—Bry. Eur. pl. 47 & 48, in part as var. β ; Braithw. l. c. pl. 25E; Dixon, l. c. pl. 9N. With the range of the species but extending into the mountains of New England and New York.

The difference in the capsules as described is very striking, but no other different characters seem constantly correlated with this. The papillosity of the leaves is exceedingly variable.

2. ONCOPHORUS JENNERI (Schimp.) Williams, N. Am. Flora 15²: 99. 1913.

Didymodon Jenneri Schimp.; Howie, Trans. Bot. Soc. Edinb. 9: 314. pl. 5. 1868.

Cynodontium polycarpon laxirete Dixon, Handb. Brit. Mosses (Ed. 1) 73. 1896.

Cynodontium polycarpon var. *laevifolia* Hagen, Musc. Norv. Bor. 8. 1898-99.

This has the large annulus and the crenulate-margined operculum of *O. polycarpon* but the plants are larger, capsules longer, up to 2.5 mm., with a neck twice as long; leaves up to 6 mm., wider, especially in the upper part; margins of a single layer, plane farther down from the apex, irregularly serrulate to almost entire; leaf cells larger, 12-20 μ , more regularly quadrate, quite smooth, except on the margin, more transparent; spores in May.

ILLUSTRATIONS:—Schimp. l. c.; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 10A; Pl. 41.

Very rare; Sheep Camp, Dyea Creek, Yukon (Williams); near Olympic Hot Springs, Washington (Foster); Burnside Road, Victoria, Vancouver Id., May 11, 1893 (J. Macoun, as *Cynodontium strumiferum*). This was numbered 63 on a label originally printed as Canadian Musci 612, and is in fine but very slightly immature fruit.

3. ONCOPHORUS TENELLUS (Bry. Eur.) Williams, N. Am. Flora 15²: 101. 1913.

Dicranum gracilescens tenellum Bry. Eur. fasc. 37-40. pl. 467. 1847.

Cynodontium alpestre Milde, Bryol. Siles. 51, in part. 1869.

Cynodontium tenellum Limpr. Krypt.-Fl. Schles. 1: 425. 1877.

Cynodontium torquescens Limpr. Laubm. 1: 288. 1886.

Cynodontium subalpestre Kindb.; Macoun, Cat. Can. Pl. 6: 257. 1892.

Plants usually short and compact, very dark except at growing tips, rarely more than 1 or 2 cm. high; leaves linear-lanceolate, up to 3 mm. long. Annulus lacking; operculum nearly entire on margin; peristome teeth mostly split 2/3 the way down. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. l. c.; Pl. 41.

EXSICCATI:—Aust. Musc. Appal. 467; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 57; Holz. Musc. Acro. Bor. Am. 304, 659.

Labrador to Alaska, south to the Mountains of New England, Minnesota and Montana.

While the general run of the plants referred to this species by Williams in the herbarium of the New York Botanical Garden are short and compact with fewer elongated basal cells than in *O. polycarpon*, the only constant difference I have been able to find is the lack of annulus. Usually, however, the operculum is less crenulate at base and shorter, the beak, 1.5-2 times the length of the conic base. Also the teeth usually split farther down. As most of the plants hitherto collected are deoperculate, definite determination is difficult. In most cases the spores seem to mature in autumn, though some collected near Lake Michigan seemed to mature in summer.

Perhaps the leaves are never as rough as in some plants of *polycarpon*, but they are fully as rough as in other plants of that species.

4. ONCOPHORUS GRACILESCENS (Web. & Mohr.) Lindb. Musci Scand. 27. 1879.

Dicranum gracilescens Web. & Mohr. Bot. Tasch. 467. 1807.

Campylopus cirrhatus Brid. Bryol. Univ. 1: 479. 1826.

Cynodontium gracilescens Schimp. Coroll. Bry. Eur. 12. 1855.

Plants in compact green tufts, brown and tomentose below; stems branching, up to 5 cm. long; leaves crisped when dry, narrowly lanceolate, up to 3 mm. long, narrowly or obtusely acute; margins of a single thickness of cells, mostly somewhat recurved along the middle portion, papillose-serrulate more than 1/2 the way down; costa scarcely percurrent, rough on the back in the upper 3/4 with upwards-inclined long sharp papillae; upper leaf cells obscure, small, rounded-quadrate, 7-10 μ wide, highly and coarsely papillose; basal cells smooth, rectangular, pellucid, alar slightly or not at all differentiated; perichaetial leaves loosely sheathing, shorter and rather abruptly narrowed to an upper portion which may be very short and smooth in the inner, or longer and rough in the outer. Autoicous; seta erect or more or less flexuous, up to 15 mm. long; capsule short-oblong, symmetric or more frequently slightly unsymmetric and cernuous, not strumose, plainly striate when dry and empty; urn with the short neck 1.5-2 mm. long; annulus lacking; operculum somewhat irregular at the base, with a beak 2/3 the length of the capsule; peristome teeth divided 2/3 the way down into two (rarely 3) slender forks, red and longitudinally striate below, paler and papillose above; spores rough, up to 21 μ , mature in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl.* 45; Limpr. Laubm. 1: *f.* 105; Braithw. Brit. Moss Fl. 1: *pl.* 25D; *Pl.* 42. On cool moist ledges, mostly at high elevations or latitudes; very rare; Kakabeca Falls, Port Arthur, Ontario (Macoun, 1869); Near trestle above Tolland, Colorado (Grout, 1914).

What some authors call an annulus consists of two rows of very small cells persistent around the capsule mouth. Dixon's description in Ed. 3 does not seem to fit American and continental plants very closely, they are usually more robust than many forms of *O. polycarpus*. Sterile this species is likely to be mistaken for *Dichodontium pellucidum* from which it differs in the narrower and more acute leaves. In fruit the strongly striate dry capsules distinguish it at once. A careful search through the *D. pellucidum* in American herbaria will doubtless discover more of this rare species.

5. ONCOPHORUS STRUMULOSUS (C. M. & Kindb.) E. G. Britton, N. Am. Flora 15²: 100. 1913.

Cynodontium strumulosum C. M. & Kindb.; Macoun, Cat. Can. Pl. 6: 16. 1892.

Plants strongly resembling *O. gracilescens*, differing as follows: smaller, about 1.5 mm. high, leaves up to 2 mm. long, narrowly oblong-linear; costa rough on the back about $\frac{1}{2}$ the way down; upper leaf cells distinct, 9–15 μ wide, rounded-quadrate to rectangular or irregular, with papillae about the same or lower; perichaetial leaves longer and narrower. Seta up to 1 cm. long; urn up to 1 mm. long; capsule sometimes strumose, less strongly striate. Type from Hector, Rocky Mts., British Columbia (Macoun). Type examined. *Pl.* 45.

6. ONCOPHORUS ALPESTRIS (Wahlenb.) Lindb. Musc. Scand. 27. 1879.

Dicranum alpestre Wahlenb. Fl. Lapp. 339. 1812.

Distinguished from *O. gracilescens* by the smaller size and rounded obtuse leaves. Reported from Greenland (Lange, Conspectus Fl. Groenl. 397. 1880). Apparently there are no specimens in American herbaria. *Pl.* 41.

7. ONCOPHORUS SCHISTI (Wahlenb.) Lindb. Musc. Scand. 27. 1879.

Weisia Schisti Wahlenb. Fl. Lapp. 325. 1812.

Rhabdoweisia Schisti Bry. Eur. fasc. 33–36. *pl.* 43. 1846.

Cynodontium Schisti Lindb. Oefv. Sv. Vet.-Akad. Förh. 21: 230. 1864.

Cnestrum Schisti Hagen, Kgl. Norsk. Vid. Selsk. Skrift. 1914: 23. 1915.

Plants in rather compact green sods; stems branching, up to 2 cm. long, usually shorter, tomentose below; leaves crisped when dry, the lower shorter, ovate-lanceolate, the upper much longer, up to 1.8 mm. long, linear-lanceolate, acute, keeled; margin crenulate-serrulate, of two layers of cells, *recurved to below the pellucid cells; costa stout, ending below the apex*, in cross section with two or three median guide cells and a stereid band above and below, the upper band weaker and sometimes failing; upper leaf cells obscure, irregularly quadrate, 7–9 μ wide, *papillose both sides with a single large conical papilla*; basal cells paler, smooth, rectangular; perichaetial leaves little different, perhaps a little more sheathing. Monoicous; ♂ buds on very short stalks just below the perichaetium, 1–4 in number; seta 2–4 mm. long; capsule erect and symmetric, not strumose, ovoid, *urn up to 1 mm. long, ribbed when dry and empty*; annulus wanting; operculum beaked, smooth on the edge; *peristome teeth narrowly lanceolate with very slender papillose points, longitudinally striate below, not forked but occasionally perforate, of the same reddish color throughout, without median line*; spores rough, 10–16 μ in diameter, mature in spring. Type locality, Lapland.

ILLUSTRATIONS:—Bry. Eur. 1. c.; Broth. Laubm. Fenn. 71, *f.* 15D. *Pl.* 41.

EXSICCATI:—Macoun, Can. Musci 15a (according to Willams); Drumm. Musc. Am. 68 (as *Weissia striata*).

On soil near rocks and in crevices in moist cool places at high altitudes and latitudes; Montana and Wyoming to Alaska; also in northern Europe.

In general appearance this species resembles *Rhabdoweisia* more than *Oncophorus*, but is distinguished from all our species by the very strongly papillose cells as well as the bistratose margin, which last also distinguishes it from *Dichodontium* and *Oreoweisia*.

8. ONCOPHORUS VIRENS (Sw., Hedw.) Brid. Bryol. Univ. 1: 399. 1826.

Dicranum virens Hedw. Stirp. Crypt. 3: 77. *pl.* 32. 1792; Sp. Musc. 142. 1801.

Cynodontium virens Schimp. Coroll. Bry. Eur. 12. 1855.

Plants in wide rather close sods, bright- or yellowish-green above, brown and radiculose below, reaching 5 cm. or more in height, mostly shorter, branched; leaves not longer above, spreading when moist, crisped when dry, up to 4 mm. long, from an ovate or oblong subclasping base *rather gradually* narrowed to a lanceolate keeled upper portion, acute or subobtusate; margin entire or irregularly serrate, *recurved except near base and apex*, usually of a double thickness of cells; costa from almost percurrent to shortly excurrent, at most only slightly roughened on the back above; upper leaf cells shortly rectangular to quadrate, smooth or somewhat bulging, rather incrassate and rounded, up to 10 μ in width but distinct; basal cells paler, elongated-rectangular, reaching 40 μ in length but not much wider, becoming much shorter about the middle of the basal portion; alar cells in many of the leaves enlarged and inflated; inner perichaetial leaves somewhat more sheathing, longer and more abruptly narrowed. Seta yellowish, up to 3 cm. long; capsule light-brown, oblong, curved and unsymmetric, strumose, urn up to 2 mm. long, smooth or slightly and irregularly wrinkled when dry and empty, and slightly or not at all contracted below the mouth; annulus apparently lacking but very narrow and persistent; operculum long and obliquely beaked; peristome teeth red-brown, divided scarcely $\frac{1}{2}$ the way down, longitudinally striate nearly to the papillose tips on the outer plates, inner plates distinctly papillose; spores slightly rough, in spring (May in British Columbia). Type locality, Lapland.

ILLUSTRATIONS:—Bry. Eur. *pl.* 48; Hedw. l. c.; Braithw. Brit. Moss Fl. 1: *pl.* 25B; *Pl.* 42.

EXSICCATI:—Drumm. Musc. Am. (as *Dicranum microcarpum*) 105, in part, 106; Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 59; Macoun, Can. Mosses 26; Holz. Musc. Acro. Bor. Am. 127; Grout, Musci Perf. 130. (deoperculate).

On moist soil or rocks in cool areas, Greenland to Alaska, south to Quebec, Michigan, Minnesota, Colorado, California, and N. Mexico (Bro. Arsene); rare east of the Rocky Mts. There is considerable variation in the shape of the leaf base and the extent of the reflexing of the margin; some leaves, especially the upper and perichaetial, are a little narrower at the insertion than at the upper base, the inflated alar cells are apparently not developed in the young leaves; there is also considerable variation in the length and curvature of the capsule.

8a. Var. *SERRATUS* (Bry. Eur.) Limpr. Laubm. 1: 309. 1886.

Dicranum serratum Bry. Eur. fasc. 37-40. 1847.

Leaves coarsely serrate in the upper part. Various other characters are given by different authors but they do not seem constantly correlated. In American plants the costa seems mostly merely percurrent.

ILLUSTRATION:—Bry. Eur. *pl.* 40 γ .

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 277; Macoun, Can. Mosses 28, 488; Grout, Musci Perf. 130 (operculate).

With the typical form, not seen from east of the Rocky Mts. Sometimes on rotten wood.

9. *ONCOPHORUS WAHLENBERGII* Brid. Bryol. Univ. 1: 400. 1826.

Dicranum Richardsoni Hook. in Drumm. Musc. Am. 104. 1828.

Dicranum microcarpum Hook. l. c. 105 (in part). 1828.

Dicranum virens Wahlenbergii Hueben. Musc. Germ. 231. 1833.

Cynodontium virens Wahlenbergii Schimp. Coroll. Bry. Eur. 12. 1855.

Cynodontium Wahlenbergii Hartm. f. in Hartm. Skand. Fl. (Ed. 10) 2: 113. 1871.

Dicranum Demetrii R. & C. Bot. Gaz. 22: 1. 1896.

Differs from the preceding mainly in the characters italicised below. Upper leaves usually the longest, reaching 5 mm., *more strongly crisped, from a more completely sheathing obovate base abruptly narrowed to a longer flexuose subulate upper portion*, which has the margins serrate above (rarely entire) and less often bistratose *and mostly plane*; costa often excurrent and usually somewhat roughened on the back near the apex; elongated basal leaf cells reaching nearly to the shoulder. Type locality, Lapland.

ILLUSTRATIONS:—Bry. Eur. *pl.* 40; Jennings, Mosses Western Pa. *pl.* 8; Braithw. Brit. Moss Fl. 1: *pl.* 25A; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 10D; M. H. M. f. 35.

EXSICCATI:—Drumm. l. c.; R. & C. Musc. Am. Sept. 270; Aust. Musc. Appal. 75 (as *Dicranum virens*).

Mostly on decaying wood in moist cool shaded places; Greenland to Alaska, south to Pennsylvania, Ohio and Wyoming. Common in the mountains of New England, but usually occurring in limited quantities.

2a. Var. COMPACTUS (Funck) Bry. Eur. fasc. 37-40. 1847.

Tufts short and dense, leaves crowded, shorter, entire, base narrower. Alaska. An arctic-alpine form.

10. ONCOPHORUS RAUEI (Aust.) n. comb.

Syrrophodon ? *Rauei* Aust. Bull. Torr. Bot. Club. 6: 74. 1876.

Dicranum fulvum Hook. of Lesq. & James Man. 70. 1884.

Dicranodontium inundatum Small, Mosses Southern U. S. 51 (nomen nudum). 1897.

Austinella Rauei Williams, Bryol. 14: 70. 1911.

Symblepharis Rauei Brotherus, Engler & Prantl, Musci (Ed. 2) 201. 1924. (Not previously published by Williams.)

Plants dark yellow-green at the growing tips, fulvous to dark-brown below, growing in extensive mats; stems with central strand and about 3 rows of thick-walled outer cells, up to 3 cm. long, often branching, upper leaves up to 5 mm. long, spreading-flexuous when moist, slightly crisped when dry, from a clasping obovate base about as broad as long, abruptly narrowed to a channelled linear-lanceolate upper portion 3-4 times as long, irregularly serrate on the plane margins fully $\frac{1}{2}$ the way down, often somewhat rough on the back above, bistratose in the upper lamina; costa stout, up to $\frac{1}{4}$ the width of the leaf base, usually somewhat narrower, semiterete, and protruding on the dorsal side, in cross section with a median row of guide cells and some accessory cells near the surface, a strong stereid band above and below the median guides; basal cells rectangular, mostly incrassate, except at or near the insertion, alar only occasionally inflated; cells of the upper $\frac{1}{2}$ of the broad base incrassate, about $7\ \mu$ wide 1-4 : 1, below this point the cells become gradually longer and above shorter, in the upper lamina becoming shorter, quadrate to short-rectangular. Autoicous; antheridial buds in the leaf axils below the perichaetium; sporophyte as in the two preceding, capsule unsymmetric, inclined and strumose; spores in spring. Type locality, Onoko Glen, Pennsylvania.

ILLUSTRATIONS:—Bryol. 14: 71. f. 1; Pl. 51.

On rocks, usually at high altitudes; not rare in the Great Smokies in Tennessee and North Carolina; Blackwater Falls, Cheat River, W. Virginia, July 9, 1878 (J. D. Smith).

The dark fulvous color and rocky habitat easily distinguish this from *Wahlenbergii* with its light color and usual habitat on decayed wood. Under the microscope the stout costa and the small thick-walled cells of most of the broad base are much like those of *virens*, but the shape of the leaves and the plane margins are those of *Wahlenbergii*. After the archegonia are fertilized, the stems increase by innovations. On one stem there were 3 apparently lateral setae and below each a male flower. The dioicous plants previously described were doubtless imperfectly developed. The type of *Syrrophodon Rauei* and Small's 51 have been studied.

7. SYMBLEPHARIS Mont. Ann. Sci. Nat. II. 8: 252. 1837.

We have but one species, the type, *S. helicophylla*.

SYMBLEPHARIS HELICOPHYLLA Mont. l. c.

Symblepharis Oerstediana C. Muell. Syn. 2: 613. 1851. "

Symblepharis Chrismari C. Muell. l. c. 614.

Plants in large soft cushions, yellow-green; stems more or less branching, 2-4 cm. long, tomentose below, with a large central strand; leaves crispate when dry, from a broad obovate clasping base 1 mm. or more in length, rather abruptly narrowed to a widely spreading, slender channelled upper portion 4-5 times as long, with flat unistratose margins, entire or serrulate near the apex; costa percurrent or somewhat excurrent, smooth except at the apex, in cross section near the middle showing a row of 7 or 8 guide cells with a stereid band both above and below; leaf cells smooth, those of the clasping base clear and pale, often brownish, elongated-rectangular up to $12 \times 125\ \mu$; cells of the narrower part smaller and denser, $6-8\ \mu$ wide and quadrate to short-rectangular; perichaetial leaves similar but with a longer clasping base. Autoicous, antheridial bud short-stalked, at a varying distance below the perichaetium. Setae often aggregate, about 1 cm. long, erect and straight or nearly so; capsule 2-3 mm. long, cylindric, erect and symmetric or nearly so, not strumose, with small stomata at the base, reddish around the mouth; operculum rostrate, much shorter than the urn; annulus lacking; peristome teeth inserted below the capsule mouth, reddish, split well down, more or less striate longitudinally and strongly papillose, especially on the inner face; calyptra not split, slightly rough at apex; spores up to $30\ \mu$, thick-walled, maturing in winter. Type locality, Oaxaca.

ILLUSTRATIONS:—Journ. Linn. Soc. 33: *pl.* 25; *Pl.* 45.

EXSICCATI:—Pringle, Musci Mex. 544, 10441.

On decaying wood and probably on soil near top of Mt. Lemon, Pima Co., Arizona, Jan. 15, 1923 (Bartram no. 497). Also Mexico to Panama, and in Asia.

Bartram's plants grew on a log and if sterile could with difficulty be told from *Oncophorus Wahlenbergii*, the leaves are more strongly denticulate above than in the Asiatic plants studied.

8. DICRANOWEISIA Lindb. Oefv. Sv. Vet.-Akad. Förh. 21: 230. 1864.

Plants small, in dense sods, with branching stems; leaves crisped when dry, lanceolate to subulate from an oblong base, entire, acute to subacute; costa nearly or quite percurrent; upper leaf cells small, nearly isodiametric, rounded-quadrate, smooth or slightly papillose; the lower elongated and hyaline, rectangular; inner perichaetial leaves often broadly obtuse or short-acuminate and sheathing. Autoicous; seta erect, straight, long exserted; capsules oblong to cylindric, erect and symmetric, smooth or irregularly wrinkled when dry but not contracted below the mouth; annulus present or lacking, operculum slenderly beaked; calyptra smooth, not fringed; peristome teeth inserted below the capsule mouth, lanceolate, entire or occasionally split at the apex, usually papillose on the outer face, occasionally somewhat striate near the middle, with median line faint or lacking. Type species, *D. cirrhata*.

KEY.

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|---|------------------------------|
| 1. Leaf margins revolute, alar cells not differentiated..... | 1. <i>cirrhata</i> . |
| Leaf margins plane, somewhat incurved..... | 2. |
| 2. Alar cells distinctly enlarged and inflated in many leaves..... | 3. |
| Alar cells scarcely different from the other basal..... | 4. |
| 3. Leaves up to 4 mm. long; subula much longer than the basal part; stereid bands present in costa..... | 2. <i>crispula</i> . |
| Leaves less than 2 mm. long; subula little or not at all longer than the basal part; costa without stereid bands..... | 4. <i>subcompacta</i> . |
| 4. Subula of perichaetial leaves shorter than the clasping base; capsule oblong..... | 2a. var. <i>contermina</i> . |
| Subula of perichaetial leaves 2-3 times the length of the wider clasping base; capsules ovoid..... | 3. <i>Roellii</i> . |

1. DICRANOWEISIA CIRRHATA (L., Hedw.) Lindb. l. c.

Weisia cirrhata Hedw. Sp. Musc. 69. 1801.

Plants in close sods, mostly yellowish-green; stems 1-2 cm. long; leaves spreading, flexuous, strongly crisped when dry, gradually linear-lanceolate from a broader lanceolate base, 2-3 mm. long, channelled above, gradually acute or narrowly obtuse; margins entire, *often of a double row of cells above and more or less recurved*; costa vanishing in the apex, 40-60 μ wide at base, smooth on the back above; upper leaf cells rounded-quadrate or short-rectangular, in regular longitudinal rows, 8-12 μ wide, smaller at the margin, smooth, nearing the base growing gradually larger, longer and thinner-walled, at the base about 12 μ wide, 4-6 : 1, shorter near the margin, alar not differentiated; inner perichaetial leaves clasping at base and more shortly acuminate, the innermost often short and broadly obtuse, with a thinner costa. Autoicous; σ^7 buds a little below the perichaetium or on a very short branch; seta 6-10 mm. long; capsule oblong-cylindric, erect and symmetric, narrower and darker colored at the mouth, urn 1.5-2 mm. long, pale brown; operculum long-rostrate; annulus present, narrow; peristome teeth red-brown below, paler above and often slightly papillose; spores nearly smooth, up to 16 μ in diameter, maturing late autumn to winter. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl.* 25; Braithw. Brit. Moss Fl. 1: *pl.* 19F; *Pl.* 43.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 48; R. & C. Musc. Am. Sept. 202; Allen, Mosses Cascade Mts. 12 (as *D. crispula*); Bartram, Mosses of S. Arizona 5; Holz. Musc. Acro. Bor. Am. 31; Baker, Pacific Coast Bryophytes 581.

On decaying wood bark or trees and occasionally on rocks, British Columbia to California, Arizona, and New Mexico. Frequent in elevated regions west of the divide.

2. DICRANOWEISIA CRISPULA (Hedw.) Lindb. l. c.

Weisia crispula Hedw. Sp. Musc. 68. pl. 12, f. 1-6. 1801.

Weisia convoluta C. M. & Kindb.; Macoun, Cat. Can. Pl. 6: 14. 1892.

In general appearance resembling the last, but differing clearly in the following particulars; upper leaves reaching 4 mm. in length, from a narrowly ovate or oblong base more rapidly narrowed to a slender roughened subtubulose upper portion, acute at apex and with the margins incurved; upper leaf cells averaging smaller, rarely over 8 μ wide, often slightly mamillate at back; alar cells in many leaves (not all) markedly enlarged and inflated, often colored; there is a larger number of more strongly differentiated perichaetial leaves sheathing their whole length, the inner rounded-obtuse to abruptly short-acuminate; annulus lacking; spores a little smaller, mature in early spring.

ILLUSTRATIONS:—Bry. Eur. pl. 26; Braithw. Brit. Moss Fl. 1: pl. 19E; Pl. 43.

EXSICCATI:—Drumm. Musc. Am. 69; Macoun, Can. Mosses 24.

On rocks in mountains; Alaska to California and eastward in the Rocky Mts.; also in Greenland, Labrador; Mt. Marcy, N. Y.; Mt. Katahdin, Maine; Copper Harbor, Keweenaw Co., Michigan.

Our American plants vary even more widely than the European. The following seem better treated as varieties rather than species.

2a. Var. CONTERMINA (R. & C.) n. comb.

Dicranoweisia contermina R. & C.; Holz. Contr. U. S. Nat. Herbarium 3: 269. 1895.

Alar cells as a rule little or not at all differentiated; upper leaf cells often slightly mamillate; inner perichaetial leaves usually abruptly acuminate, often shortly so and often with the acumination consisting solely of the excurrent costa. Holz. Musc. Acro. Bor. Am. 261. Apparently found throughout the western range of the species.

Cardot and Thériot, Proc. Wash. Acad. Sci. 4: 294, state that they regard *D. contermina* as a variety rather than a species. In Macoun's Can. Mosses no. 24 and in Montana plants sent to Mrs. Britton by Kelsey, some of the capsules are curved and unsymmetric and some are as long as in *D. cirrhata*.

2b. Var. COMPACTA (Schleich.) Lindb. Musc. Scand. 25. 1879.

A stunted alpine form; tufts shorter and thicker; leaves shorter and more obtuse, less crisped; basal cells shorter and broader. Reported by Williams from Montana (Bull. N. Y. Bot. Gard. 2: 352. 1902) but not noted by him in his treatment of the species in N. Am. Flora 15²: 96.

D. crispula var. *nigrescens* Nees & Hornsch. is another form mentioned by Holzinger as occurring in Alaska (Pub. Puget Sound Biol. Sta. 3: 32. 1921). Limpricht, Laubm. 265, says of this that it is scarcely worthy to be called a form.

3. DICRANOWEISIA ROELLII Kindb.; Roell, Hedwigia 35: 59. 1896.

Plants small, scarcely 1 cm. high; stem leaves crispate, up to 2.5 cm. long, from a lanceolate base gradually narrowed to a long slender acumination, which is strongly papillose-roughened and not serrulate; costa long-excurrent; upper leaf cells somewhat mamillate at back, incrassate, rounded-quadrate to short-rectangular, about 7 μ wide; lower leaf cells rectangular and longer, alar scarcely differentiated; perichaetial leaves more abruptly narrowed from a wider ovate clasping base, the slender subula 2 or 3 times the length of the broad base. Autoicous; seta less than 1 mm. long; capsule ovoid, urn up to 1.5 mm. long, more narrowed at the mouth than in the preceding; peristome teeth papillose throughout. Type locality, Mt. Hood, Oregon, alt. 8000 ft. Also collected on Mt. Rainier, 9000 ft. (Flett). Collected in one other locality on each mountain by different collectors. All four collections in the herbarium of the N. Y. Botanical Garden. Type seen and studied. Pl. 45.

4. DICRANOWEISIA SUBCOMPACTA Card. & Thér.; Holz. Bot. Gaz. 30: 122. Pl. 11, f. 1. 1900.

Plants in dense cushions; stems branching, up to 8 mm. long; leaves appressed when dry, only slightly spreading when moist, not crisped, reaching 1.5 mm. in length, from an ovate concave base gradually narrowed to a stout or slender acute subula, which may be smooth or somewhat roughened; margin plane, sometimes incurved, entire; costa percurrent to excurrent, in cross section with about 3 median guide cells

and no *stereoid bands*, often pale and narrow (below near the base) 15-45 μ wide; upper leaf cells subquadrate, rectangular or irregular, about 10 μ wide, narrower on the margin; the cells in $\frac{1}{2}$ - $\frac{2}{3}$ the leaf base much longer and more pellucid; alar cells in some leaves enlarged and inflated, in others not much different; archegonia and antheridia or sporophyte unknown. Type locality, along the trail from Holzinger's Basin to the Rim, Vicinity of Lake McDonald, Flathead Co., Montana, at base of glacier (Holzinger & Blake, July 1898). Type seen and studied. *Pl.* 42.

There is a striking likeness between this species and *Dicranum hispidulum* Williams, both collected in the same vicinity. The latter has a rough and stouter subula and all but the lower basal cells smaller.

It is probable that this plant should be referred to *Arctoa* rather than *Dicranoweisia* and it may prove to be but a phase of *D. hispidulum*. *D. obliqua* Kindb. Ottawa Nat. 5: 195. 1892 is, according to Williams, *Dicranum Schisti* (N. Am. Flora 15²: 97.)

9. ARCTOA Bry. Eur. fasc. 33-36. *pl.* 86 & 87. 1846. Emend.

Small plants, mostly less than 3 cm. high, mainly arctic or alpine; leaves mostly lanceolate from a broader base, often secund; costa semiterete, excurrent, in cross section with homogeneous cells, those corresponding to guide cells a little larger; leaf cells more or less incrassate, the lower rarely pitted next the costa; basal cells longer, the alar more or less differentiated and inflated. Autoicous; capsules erect and symmetric (*Euarctoa*) and not strumose, or curved, unsymmetric and strumose (*Kiaeria* Hag.); beak of calyptra often papillose-roughened; peristome teeth divided to the middle, or sometimes merely perforate or split along the median line; annulus usually present, sometimes compound. Type species, *A. fulvella*.

The homogeneous cells of the costa alone would seem to justify treating this group as a distinct genus; the differences in the capsules hardly justify making *Kiaeria* a separate genus from the species originally assigned to *Arctoa*.

KEY.

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| 1. Capsules erect and symmetric or nearly so, not strumose; spores 20-28 μ in diameter... | 2. |
| Capsules curved and cernuous, more or less strumose; spores 13-16 μ in diameter..... | 3. |
| 2. Upper leaf cells linear, 2-5 : 1..... | 2. <i>fulvella</i> . |
| Upper leaf cells rectangular, 1-2 : 1..... | 1. <i>hypoborea</i> . |
| 3. Alar cells little differentiated; annulus obscure, remaining attached..... | 3. <i>falcata</i> . |
| Alar cells differentiated, usually inflated; annulus large, dehiscent..... | 4. |
| 4. Leaves usually falcate-secund; upper leaf cells smooth or slightly bulging, median 2-4 : 1; | |
| capsules furrowed when dry and empty..... | 4. <i>Starkei</i> . |
| Leaves little or not at all secund; upper leaf cells plainly bulging-mamillose, median | |
| rarely over 2 : 1; capsule smooth or nearly so when dry and empty..... | 5. <i>Blythii</i> . |

1. ARCTOA HYPERBOREA (Gunn., Smith) Bry. Eur. fasc. 33-36. *pl.* 87. 1846.

Dicranum hyperboreum Smith, Fl. Brit. 1227. 1804.

Cynodontium hyperboreum Hagen, Kgl. Norsk. Vid. Selsk. Skrift. 1914: 98. 1915.

Dicranella cerviculatula Kindb. Ottawa Nat. 5: 195. 1892.

Plants in dark-green compact tufts; stems 1-5 cm. long, more or less branching and radiculose; leaves erect-flexuous, somewhat incurved and contorted when dry, erect-spreading when moist, 3-5 mm. long, from an ovate-lanceolate base with incurved margins gradually narrowed to a slender channelled upper portion slightly toothed above; costa about $\frac{1}{8}$ - $\frac{1}{6}$ the width of the leaf base, often slightly papillose on the back above, excurrent; leaf cells smooth, incrassate, in the upper part square to rectangular, 8-12 x 10-20 μ , 1-2 : 1, alar cells more or less distinctly inflated and colored; seta erect, 5-8 mm. long, as long or longer than the perichaetial leaves; capsule short-oblong to obovoid, erect and symmetric, or slightly inclined, about 1.5 x 1 mm., furrowed when dry and empty; operculum conic-rostrate with beak oblique; annulus well developed; peristome teeth mostly divided to below the middle, papillose above; spores up to 30 μ , mature in summer. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. 1. c.; *Pl.* 45.

On rocks; arctic-alpine, very rare; Greenland, Labrador, Hudson Strait; Mt. Hood, Oregon.

The length of the seta is so variable that it is of no use in distinguishing this from the next, but the upper leaf cells as described are very distinctive; leaves with strongly inflated alar cells are rare in this species, but frequent in the next.

2. ARCTOA FULVELLA (Dicks.) Bry. Eur. l. c.

Bryum fulvellum Dicks. Pl. Crypt. Brit. 4: 10. 1801.

Plants in compact, dark-green tufts; stems branching, 1–3 cm. long; leaves erect-flexuous to somewhat secund; leaves 2–3 mm. long, from an ovate-lanceolate concave base gradually narrowed to a long slender upper portion, which is more or less rough and often serrulate near the apex; margins plane, incurved below and entire; costa long excurrent, 40–60 μ wide at base; leaf cells somewhat incrassate, those in the upper narrow part linear, about 8 μ wide, 15–50 μ long, 2–5 : 1, near the base and costa a little wider and reaching 75 μ in length, often somewhat pitted, marginal cells shorter throughout; alar cells more or less plainly enlarged and inflated, immediately above these a few short-rectangular or quadrate cells; perichaetial leaves longer, sheathing 2/3 their length, often reaching the capsules or beyond, their basal cells longer. Male bud on a more or less distinct branch below the perichaetium; seta 2–4 mm. long, erect, often much shorter than the perichaetial leaves; capsule nearly or quite erect and symmetric, obovoid, with a short neck, urn about 1 mm. long, and sometimes nearly as wide when flattened on a slide, distinctly furrowed when dry, wide-mouthed and subturbinate; operculum short-beaked; annulus narrow, of about two rows of small cells and persistent (in specimens studied); peristome teeth split half way, or merely perforate or slit, red, longitudinally striate with irregular lines and coarsely papillose below, at the tips colorless and nearly smooth; spores rough, up to 24 μ in diameter, mature in July. Type locality, Ben More, Scotland.

ILLUSTRATIONS:—Bry. Eur. pl. 86; Limpr. Laubm. 1: 338, f. 117; Braithw. Brit. Moss Fl.: 1: pl. 19G. Pl. 43.

On rocks and in crevices (non-calcareous); White Mts. of New Hampshire; Adirondacks of N. Y.; near Toxaway, N. Carolina (Sharp); Yukon.

Arctoa Andersoni Wich. Flora 42: 432. pl. 7, has been reported from Port Wells, Alaska. The chief distinctions Williams (N. Am. Fl. 15: 115, 116) makes are the immersed capsules and split teeth; but not only the Mt. Washington specimens, but also many of the European of *A. fulvella* have the perichaetial leaves extending well beyond the capsule and many of the peristome teeth split 1/2 the way down. Brotherus (Laubm. Fennosk. 86) describes the leaf base of *fulvella* as oblong and that of *Andersoni* as broadly ovate. Williams (l. c.) does not make this distinction. Most authors also emphasize the shorter capsule, nearly as broad as long, but this also is true of the Mt. Washington plants which have been identified as *fulvella* by every one who has studied them.

The slight roughening at the tip of the calyptra in *fulvellum* is scarcely noticeable

3. ARCTOA FALCATA (Hedw.) n. comb.

Dicranum falcatum Hedw. Sp. Musc. 150. pl. 32. 1801.

Oncophorus falcatus Brid. Bryol. Univ. 1: 393. 1826.

Kiaeria falcata Hagen, D. K. N. Vid. Selsk. Skrift. 1914: 112. 1915.

Plants in compact sods, green above, brown below; stems branching, up to 4 cm. high, usually shorter; leaves typically regularly falcate-secund, especially at the summit of the stems, not much changed in drying, gradually long-linear from a lanceolate base, subtubulose below by the incurved plane margins, entire or subserrulate near apex, 3–4 mm. long; costa usually long-excurrent and rough above with coarse papillae, 1/5–1/7 the width of the leaf base; upper cells of leaf blade about 6 μ wide, 1–2 : 1, short rectangular to subquadrate, with moderately thick walls, smooth or bulging-papillose above; lower cells larger, up to 15 x 60 μ ; alar cells only moderately differentiated; marginal cells smaller nearly throughout; perichaetial leaves from a broader longer sheathing base and having a larger area of larger elongated cells, the inner more abruptly narrowed. Autoicous; male bud close below the perichaetium; seta erect, 5–12 mm. long; capsule 1–1.5 mm. long, ovoid, suberect to cernuous, more or less curved and strumose, smooth or slightly shriveled and contracted below the mouth when dry; exothecial cells short, rarely over 2–3 : 1, rather thick-walled, usually with a single row of stomata about the base of the spore sac; operculum rostrate, with beak about 2/3 the length of the urn; calyptra finely and closely papillose to near the split base; annulus poorly developed, of small persistent cells, scarcely evident as such; peristome teeth red, divided about 1/2 down, strongly papillose and more or less longitudinally striate below; spores 14–18 μ , mature in summer. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl.* 65; Braithw. Brit. Moss Fl. 1: *pl.* 20B; Dixon, Handbk. Brit. Mosses (Ed. 3) *pl.* 13E; *Pl.* 43.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 293, 433; Allen, Mosses Cascade Mts. 10.

On rocks and soil in moist shaded places at high altitudes and latitudes; Washington and Oregon, northwards to Alaska.

The characters italicized above will serve to identify perfect fruiting specimens, but depauperate sterile specimens with the leaves papillose above and hardly secund are troublesome. The species is apparently not rare on Mt. Rainier at 5500–7000 ft.

4. ARCTOA STARKEI (Web. & Mohr.) n. comb.

Dicranum Starkei Web. & Mohr. Bot. Tasch. 189, 471. 1807.

Oncophorus Starkei Brid. Bryol. Univ. 1: 394. 1826.

Kiaeria Starkei Hagen, l. c. 114.

Resembles *A. falcata* in many particulars, averaging larger with leaves often less regularly falcate from a broader ovate-lanceolate base, more frequently denticulate farther down from the apex; leaf cells in the narrower upper portion of the leaf longer, 2–4 : 1; alar cells well differentiated, inflated and brown, just above these a group of smaller quadrate cells. Capsule oblong, urn up to 2 mm. long, curved, cernuous, more or less strumose, narrowed at the mouth and more or less plainly furrowed when dry and empty; exothecial cells longer with thinner wall; annulus broad, of 2–3 rows of cells, dehiscent; peristome teeth with very coarse papillae and rather faint and irregular longitudinal-oblique lines; calyptra often not quite as rough; spores in summer. Type locality, Silesia.

ILLUSTRATIONS:—Bry. Eur. *pl.* 64; Braithw. Brit. Moss. Fl. 1: *pl.* 20C; Dixon, Handbk. Brit. Mosses *pl.* 13G; *Pl.* 43.

EXSICCATI:—Grout, Musci Perf. 91.

Habitat much as in the preceding; mountains of New England; Montana to Washington and north to Alaska, rare.

Williams (N. Am. Flora 15²: 118) states that the eastern plants referred to this species "do not seem to be typical." Typical plants are quite distinct but the calyptra varies in roughness, the leaf cells in length, and the upper are often bulging-papillose, also the capsules are in some cases nearly smooth. In other words the four species of the *Kiaeria* subgenus intergrade along some lines. There are considerable differences in the length of leaf cells in this species but they are consistently longer than in any others of the *Kiaeria* group and in American plants the leaf cells in the median portion of the leaf are consistently shorter than in the European, approaching *A. Blythii*.

5. ARCTOA BLYTHII (Bry. Eur.) n. comb.

Dicranum Blythii Bry. Eur. fasc. 37–40. *pl.* 63. 1847.

Dicranum Schisti (Gunn.) Lindb. Act. Soc. Sci. Fenn. 10: 11. 1871.

Dicranoweisia obliqua Kindb. Ottawa Nat. 5: 195. 1892.

Cynodontium Treleasei Card. & Thér. Proc. Wash. Acad. Sci. 4: 295. 1902.

Kiaeria Blythii Broth. Laubm. Fennosk. 87. 1923.

At best a subspecies of *A. Starkei* and grading into it in nearly every character in various specimens studied. The leaves are rarely falcate-secund, usually flexuose and somewhat crisped when dry, usually a little shorter; excurrent costa rougher and the upper leaf cells shorter and more conspicuously bulging-mamillose. ♂ buds on the stem well below the perichaetium or on a short branch, sometimes on a separate plant; capsule typically shorter, smooth and less strumose. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. *pl.* 63; Dixon, Handbk. Brit. Mosses *pl.* 13F; *Pl.* 43.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 229 (as *Dicranum Starkei*).

Crevices of mountain rocks; mountains of New Hampshire and New York; Oregon, Washington and Idaho to Alaska; rare.

The plants from Mt. Washington, New Hampshire, are intermediate between this and *A. Starkei* in leaf structure. The western plants are more like the European.

5a. Var. HISPIDULA (Williams) n. comb.

Dicranum hispidulum Williams, Bull. N. Y. Bot. Gard. 2: 353. *pl.* 34. 1902.

Plants smaller; leaves equally spreading when moist, incurved flexuose when dry, rough on the back in the upper half or more with stout crowded mamillate papillae, broadly ovate-lanceolate, acuminate rather

than long-subulate, scarcely 2 mm. long; leaf cells of the middle lamina about 10 μ wide, 1-2 : 1, quadrate, rectangular or irregular; spores nearly smooth, up to 12 μ in diameter, mature in summer. Type locality, Macdonald Lake, Great Northern R. R., Montana. Also collected by E. T. Bodenbergh in three different localities on Mt. Rainier, Washington, alt. about 6000 ft. Holzinger's 229 approaches this variety.

Dicranoweisia subcompacta Card. & Thér. was from the same region as this variety. It is very like *Arctoa Blyttii* except for lack of prominent papillae and it is nearer this than any form of *Dicranoweisia*. Pl. 44.

10. DICRANUM Hedw. Fundam. 2: 91. 1782; Sp. Musc. 126. 1801.

Plants in loose to dense sods, from 2-12 cm. or more in height; leaves broadly to narrowly lanceolate, mostly falcate-secund; costa semiterete, mostly percurrent to excurrent, in cross section near the middle with median guide cells and smaller cells below and above, which usually form distinct stereid bands, often toothed on the back, with or without distinct ribs; upper leaf cells mostly smooth, papillose in a few species; margins unistratose, never recurved above, more or less incurved; alar cells strongly differentiated, enlarged and inflated, often colored. Dioicous, except *D. arcticum*; setae erect, single or clustered; capsules mostly cylindric, erect and symmetric or curved and cernuous and often strumose, operculum long-rostrate; annulus usually well developed; peristome teeth red, inserted near the capsule mouth, confluent at the base, divided about $\frac{1}{2}$ the way down into 2-3 forks, mostly striate vertically on the outside and more or less strongly papillose; calyptra cucullate, not ciliate at base. Type species, *D. scoparium*.

KEY.*

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| 1. Capsules straight and erect or nearly so, never strumose; leaf cells not pitted except in <i>D. rhabdocarpum</i> (<i>Orthodicranum</i>); (<i>D. groenlandicum</i> may be sought here)..... | 2. |
| Capsules curved and cernuous, strumose in some species (<i>Eudicranum</i>)..... | 6. |
| 2. Leaves papillose on the back about $\frac{1}{2}$ the way down, crisped when dry, not secund..... | 1. <i>montanum</i> . |
| Leaves smooth on the back or slightly rough near the apex, straight, or more or less secund and crisped..... | 3. |
| 3. Costa excurrent in all leaves..... | 4. |
| Costa not excurrent (with rare exceptions and in few leaves)..... | 5. |
| 4. Plants fulvous except at growing tips; costa with 2 stereid bands; annulus present; nearly always on rocks (except var. a)..... | 3. <i>fulvum</i> . |
| Plants green to pale green; costa without stereid bands; annulus lacking; usually on wood, rarely on rocks..... | 4. <i>strictum</i> . |
| 5. Stems usually bearing flagella in the axils of the upper leaves, which are somewhat crisped; annulus present; upper leaf cells 1-1.5 : 1..... | 2. <i>flagellare</i> . |
| Stems without flagella; annulus lacking; upper leaf cells elongate..... | 5. <i>rhabdocarpum</i> . |
| 6. Upper leaf cells 1-2 : 1, rarely more, their walls not pitted..... | 7. |
| Upper leaf cells more elongated, more or less pitted..... | 17. |
| 7. Plants robust; leaves undulate or rugose..... | 8. |
| Plants medium sized to slender (except <i>Muhlenbeckii</i>); leaves not rugose (except occasionally in <i>condensatum</i>)..... | 10. |
| 8. Leaves erect-open when dry, rarely somewhat crisped, obtuse..... | 8. <i>Bergeri</i> . |
| Leaves more or less crisped when dry, acute..... | 9. |
| 9. Leaves ovate to ovate-lanceolate, widest a little below the middle, finely papillose over all the upper dorsal surface; setae solitary..... | 11. <i>spurium</i> . |
| Leaves oblong-lanceolate, broadest at or near the base, more or less roughened with coarse papillae on the upper dorsal surface; setae usually aggregate... | 9. <i>Drummondii</i> . |
| 10. Leaves strongly falcate-secund and crisped when dry..... | 6. <i>fuscescens</i> . |
| Leaves not secund, often straight..... | 11. |

* There are 3 species whose slender leaf tips are almost all broken off, *fulvum* var. *viride*, *strictum*, and *fragilifolium*; for distinctions see under the last.

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| 11. Plants stout; leaves broadly lanceolate, more or less crispate when dry; capsule 3-4 mm. long..... | 12. |
| Plants slender; leaves straight or nearly so; capsules rarely over 2 mm. long.... | 13. |
| 12. Leaves subtubulose above; costa about 1/5-1/6 width of leaf base..... | 7. <i>Muhlenbeckii</i> . |
| Leaves merely channelled above; costa 1/8 width of leaf base or less..... | 10. <i>condensatum</i> . |
| 13. Leaves with points mostly broken; costa long-excurrent..... | 12. <i>fragilifolium</i> . |
| Leaves rarely broken; costa ending in apex to shortly excurrent..... | 14. |
| 14. Leaves blunt, mostly smooth at apex; costa ending in the apex to percurrent... | 15. |
| Leaves acute and slender pointed; costa percurrent to excurrent..... | 16. |
| 15. Upper leaf cells 1-2 : 1..... | 15. <i>groenlandicum</i> . |
| *Upper leaf cells 2-4 : 1..... | 16. <i>laevidens</i> . |
| 16. Costa 1/5-1/4 width of leaf base..... | 13. <i>elongatum</i> . |
| Costa about 1/9 width of leaf base..... | 14. <i>spadiceum</i> . |
| 17. Leaves undulate; setae aggregate..... | 18. <i>rugosum</i> . |
| Leaves not undulate (sometimes slightly so in <i>Bonjeani</i>)..... | 18. |
| 18. Plants largest of the genus; setae aggregate..... | 19. <i>majus</i> . |
| Plants less robust or slender; setae solitary..... | 19. |
| 19. Plants slender; leaves nearly straight, smooth or nearly so..... | 21. |
| Plants robust; leaves usually strongly serrate above..... | 20. |
| 20. Leaves with a slender strongly serrate apex, strongly falcate-secund (except vars.) never undulate..... | 20. <i>scoparium</i> . |
| Leaves laxly spreading, rarely secund (except var. <i>alatum</i>), sometimes slightly undulate, with broad, often obtuse, apex..... | *21. <i>Bonjeani</i> . |
| 21. Dioicous; leaves narrowly obtuse; capsules not strumose..... | 16. <i>laevidens</i> . |
| Monoicous; leaves slenderly acute; capsules strumose..... | 17. <i>arcticum</i> . |

1. DICRANUM MONTANUM Hedw. Sp. Musc. 143. 1801.

Plants *light yellowish-green*; stems usually about 1 cm. long, reported as occasionally reaching 4 cm.; leaves *strongly crispate when dry*, rarely, if ever, secund, erect-spreading when moist, 3-4 mm. long, narrowly long-lanceolate, concave below and channeled above, serrulate or crenulate about 1/3 down on the margins and back of costa; costa percurrent or shortly excurrent, *at base about 1/5 the width of the leaf*; cells in the upper 1/2 of the leaf quadrate to short rectangular and more or less papillose, often strongly so, 10-12 μ wide; basal cells elongate-rectangular, near the costa sometimes reaching 10 : 1, *the alar moderately enlarged and inflated*, sometimes colored, none of the cell walls pitted; inner perichaetial leaves rather loosely convolute-sheathing, more abruptly narrowed to a linear rough portion about as long as the base. Seta erect, up to about 1.5 cm. long; capsule oblong-cylindric, erect and symmetric or nearly so, somewhat furrowed irregularly when dry and empty; urn 2-2.5 mm. long; operculum long-conic, about 2/3 the length of the urn; annulus narrow; peristome teeth red, usually divided more than 1/2 the way down, vertically striate on the outside and faintly papillose; spores 14-18 μ in diameter, nearly smooth, mature late summer to early autumn. Type locality, Germany.

ILLUSTRATIONS:—Hedw. l. c. *pl.* 35, *figs.* 8-13; Bry. Eur. *pl.* 67; Jennings, Mosses W. Pa. *pl.* 8; *Pl.* 44.

EXSICCATI:—Drumm. Musc. Am. 102; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 55, (Ed. 2) 71; Aust. Musc. Appal. 81; R. & C. Musc. Am. Sept. 357; Macoun, Can. Musci 34; Holz. Musc. Acro. Bor. Am. 389, 506, both depauperate; Grout, Musci Perf. 115; Bartram Mosses of S. Arizona 52.

On stones, logs and roots of trees, mostly sterile except in the mountains; Newfoundland to Tennessee; West to Arizona and Manitoba; more abundant east of the Mississippi; common in the mountains of New England but fruiting sparingly.

2. DICRANUM FLAGELLARE Hedw. Stirp. Crypt. 3: 1. *pl.* 1. 1791; Sp. Musc. 130. 1801.

Dicranum miquelonense R. & C. Bot. Gaz. 14: 93. 1889.

Dicranum crispatum Kindb. Eur. & N. Am. Bryin. 189. 1897.

Plants in close dark- to pale-green tufts, bearing more or less abundant slender deciduous flagelliform branches from the axils of the upper leaves, these covered with minute scale-like ecostate leaves; stems

* Sterile *D. rhabdocarpum* will be sought here.

about 1 cm. or more in length; leaves 3-4 mm. long, crispate when dry and more or less secund, gradually lanceolate from an oblong base, subtubulose above by the strongly incurved margins, often nearly touching each other, nearly entire except near the apex; costa $1/7-1/5$ the width of the leaf base, nearly or quite percurrent into the broadly acute apex, rough on the back above; alar cells well differentiated and usually inflated and brownish, reaching nearly to the costa; lower leaf cells rectangular, 2-8 : 1, with slightly thickened, not pitted walls, the upper shorter 1-3 : 1, all smooth; inner perichaetial leaves from a sheathing base abruptly narrowed to a narrow subula shorter than the sheathing base. Seta 1-2 cm. long; capsule cylindric, erect and symmetric or nearly so, 2-3 mm. long, slightly wrinkled when dry and empty; operculum long-rostrate, more than $1/2$ the length of the urn; annulus narrow; peristome teeth reddish and longitudinally striate below, pale and faintly papillose above, divided at least $2/3$ the way down; spores about 15 μ in diameter, slightly roughened, mature in late summer. Type locality, Germany.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. *pl.* 68; M. H. M. f. 46; Jennings, Mosses W. Pa. *pl.* 8; Braithw. Brit. Moss Fl. 1: *pl.* 23 C; *Pl.* 44.

EXSICCATI:—Sull. Musc. Allegh. 162; Aust. Musc. Appal. 82; Sull. & Lesq. Musc. Bor. Am. (Ed. 56); Grout, Musci Perf. 141; Holz. Musc. Acro. Bor. Am. 103.

Mostly on rotten wood and peaty banks; Nova Scotia to British Columbia; south to South Carolina and Mexico. Common in the northeastern U. S. and eastern Canada.

The leaf shape varies greatly, in well developed specimens the leaves are longly and narrowly acuminate with little but costa in the upper part and when dry are crispate-falcate; in other specimens the leaves become shorter and broader at apex, 1-2 mm. long and only contorted when dry, grading into

2a. Var. MINUTISSIMUM Grout, M. H. M. 105. f. 47. 1904.

Stems only a few mm. long, growing in dense wide velvety mats over stems and peaty banks in swamps; leaves ovate-lanceolate to triangular-lanceolate, scarcely more than 1 mm. long. Type locality, Lawrence, Long Island, N. Y. Type in herb. A. J. G. M. H. M. f. 47.

Of the three common species of *Orthodicranum*, *fulvum* is readily identified by the falcate-secund leaves, dark color and broad costa; *flagellare* by the usually present flagella and smooth tubulose leaves, which may be somewhat crisped and falcate when dry or merely contorted, color lighter than *fulvum* and darker than *montanum*; *montanum* by the light color and strongly crisped leaves, more papillose at back.

"The specimens called *D. miquelonense* Ren. & Card. are about the same as the European variety growing on rock and called *D. flagellare arenaceum* (Bryotheca Silesiaca 156c). They are similar also to specimens collected in fruit by Austin at Closter, which have flagella almost wanting. These varieties all differ in having mostly shorter, smoother, rather straighter leaves, and flagella wanting." R. S. Williams, N. Am. Flora 15²: 120.

3. DICRANUM FULVUM Hook. Musci Exot. *pl.* 149. 1820.

Dicranum interruptum Bry. Eur. fasc. 37-40. *pl.* 69. 1847.

Dicranum subfulvum R. & C. Bot. Gaz. 22: 2. 1896.

Dicranum subsubulifolium Kindb. Rev. Bryol. 37: 13. 1900.

Archegonial plants *fulvous to brownish-green*, often in extensive mats; stems tomentose, up to 5 cm. long; stem leaves 5-6 mm. long, falcate-secund, occasionally somewhat crisped when dry, long-lanceolate, gradually narrowed to a channelled linear point, for the most part slightly serrulate and somewhat papillose roughened near the apex; costa $1/3$ or more of the width of the leaf base, excurrent and occupying most of the upper part of the leaf; median and upper leaf cells quadrate to short-rectangular, rarely over 2 : 1, rather incrassate and obscure, about 6 μ wide, bistratose and often lightly papillose on the back in the upper $1/3$; lower cells larger and elongate-rectangular except at the margin, not porose; alar cells differentiated, inflated and reaching to the costa; inner perichaetial leaves convolute at base, abruptly narrowed to a linear subula, the innermost sometimes truncate without subula. ♂ plants more slender, mixed with the ♀, bearing a number of rather large scattered ♂ buds; seta solitary, 1-2 cm. long; capsule erect and symmetric or nearly so, cylindric, more or less furrowed when dry and empty; urn up to 4 mm. long; annulus narrow; operculum rostrate $1/2-2/3$ the length of the urn; peristome teeth rather faintly papillose and striate, sometimes almost smooth; spores finely and closely papillose, up to 25 μ in diameter, mature in autumn. Type locality, Nova Scotia.

ILLUSTRATIONS:—Hook. l. c.; Bry. Eur. *pl.* 69; Jennings, Mosses W. Pa. *pl.* 9; M. H. M. f. 46.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 57, (Ed. 2) 73; Sull. Musc. Allegh. 159; Macoun, Can. Musci 37; Holz. Musc. Acro. Bor. Am. 104; Grout, Musci Perf. 21; Aust. Musc. Appal. 73; Drumm.? On rocks in cool shaded places; Nova Scotia to Georgia, west to Minnesota and Missouri; common in the mountains of New England and N. Y.

The capsules are smooth until empty and then irregularly furrowed and shrunken; young or depauperate plants often have the leaves very rough above.

3a Var. *VIRIDE* (Sull. & Lesq.) n. comb.

Campylopus viridis Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 72. 1856.

Dicranum viride Lindb. Hedwigia 2: 70. 1863.

Usually growing on wood with the tips of all leaves, except the young upper, broken off; when present the apices are nearly entire and little or not at all papillose at back, often producing protonema from the broken end. The plants are usually smaller than the general run of *fulvum* and the leaves are scarcely secund. Williams (N. Am. Flora 15²: 119) says "Examination of the type collection of *D. viride*, Musci Bor. Am. 72, shows leaves often quite as rough above as *D. fulvum*. Examination of a cross section of the costa of Holzinger's 388 shows no difference from that of *D. fulvum*." M. H. M. f. 48.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 388. His no. 8 is nearer the typical form; Aust. Musc. Appal. 73. [See under *D. fragilifolium* p. 84, also Dixon, Handb. Brit. Mosses (Ed. 3) 117.]

4. *DICRANUM STRICTUM* Schleich. Crypt. Helv., Cent. 3. no. 26. 1806: Schwaegr.

Suppl. 1¹: 188. *pl.* 43. 1811.

Plants in compact cushions, green to yellowish-green; stems 1–5 cm. long, tomentose below, fragile; leaves erect or slightly spreading, *nearly or quite straight when dry*, up to 7 mm. long but usually shorter, *very fragile with the upper portion usually broken off*, from a narrowly lanceolate base gradually narrowed to a slender, canaliculate-subulate upper portion, usually entire but sometimes serrulate towards the apex; costa narrow, 1/7–1/5 the width of the leaf base, long-excurrent, smooth, *without sterei bands*; alar cells distinctly inflated, hyaline or colored, rarely reaching the costa; other basal cells elongate-rectangular to linear, 4–8 : 1, with rather thin, occasionally pitted walls; other cells gradually shorter upwards, about 2 : 1, rarely quite quadrate in the upper lamina, angular and smooth; perichaetial leaves from a convolute-sheathing base gradually narrowed to a long slender subula, which is usually entire. Setae solitary, reddish-yellow, up to 2 cm. long; capsule erect and symmetric or nearly so, oblong-cylindric, up to 3 mm. long, smooth when dry and empty; operculum long-rostrate, a little shorter than the urn; *annulus* lacking; peristome teeth somewhat irregularly divided at least 1/2 the way down, nearly smooth on the outer plates below, obliquely striate and papillose above; spores about 16 μ , mature in summer. Type locality, Switzerland.

ILLUSTRATIONS:—Schwaegr. l. c.; Bry. Eur. *pl.* 66. *Pl.* 44.

EXSICCATI:—Macoun, Can. Musci 34a; Holz. Musc. Acro. Bor. Am. 635, 32 (as *D. fragilifolium*). R. & C. Musc. Am. Sept. 273; Grout, Musci Perf. 131; Allen, Mosses Cascade Mts. 7; Howe, Musci Calif. 108.*

On decaying wood, rarely on rocks or soil; from Alaska southwards to California, Idaho and Wyoming. Frequent within its range and apparently fruiting freely. (See note under *D. fragilifolium* concerning sterile plants.)

5. *DICRANUM RHABDOCARPUM* Sull. Mem. Am. Acad. 5²: 172. *pl.* 3. 1849.

Dicranum scoparioides Schimp.; Besch. Mém. Soc. Nat. Chérb. 16: 164. 1872.

♂ plants in more or less separate tufts, more slender than the ♀; ♀ plants in compact tufts, stems branching, densely radiculose below, 2–4 cm. long; leaves erect-spreading, *secund at apex of stems only, not at all crispate when dry*; stem leaves 3–5 mm. long, ovate-lanceolate, serrulate on the margins in the upper part, narrowly to broadly acute, concave below and tubulose above; *costa vanishing below the apex, 60 μ or less in width at the base*, toothed on the back above; alar cells differentiated, from moderately to greatly inflated, hyaline or golden-brown, rarely extending to the costa, the cells immediately above elongated-rectangular, wider than those near the costa, *above these the cells are elongated and pitted nearly to the apex*,

* In Howe's 108 the peristome teeth are striate to the base; in Holzinger's 635 the teeth are split and perforate to the base.

the median linear-oblong, about 8–12 μ wide, 40–60 μ long, shorter near the apex and more irregular; perichaetial leaves sheathing at base, rather abruptly narrowed to a nearly smooth slender point, $\frac{1}{2}$ the length of the base or less; seta 1.5–2.25 μ long, orange-yellow, becoming dark red with age; capsule 3–3.5 mm. long, cylindric, erect and symmetric, or sometimes slightly curved, strongly furrowed when dry; annulus lacking; operculum long-rostrate, more than $\frac{1}{2}$ the length of the capsule; peristome teeth reddish-brown, vertically striate on the outside, divided or perforate up to $\frac{3}{4}$ the length, rough with papillae and irregular ridges at the tips; spores up to 18 μ in diameter, mature in autumn. Type locality, Colorado.

ILLUSTRATIONS:—Sull. l. c.; Pl. 46.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 2) 82; Baker, plants of Colorado 110; Bartram, Mosses of S. Arizona 42; Clements, Crypt. From Colo. 196; Holz. Musc. Acro. Bor. Am. 507.

On soil, rocks, and wood, 8,000–10,000 ft., Colorado, New Mexico and Arizona; also in Mexico.

Sterile plants are likely to be mistaken for *D. Bonjeani*, but the leaves are usually acute at apex and the species appears to be exclusively of the Rocky Mts. and their southern extension. The elongated and pitted upper leaf cells distinguish it from all our other *Orthodicrana* and seem to indicate a close relationship to the *scoparium* group of *Eudicrana*.

6. DICRANUM FUSCESCENS Turn. Musc. Hib. 60. 1804.

Dicranum congestum Brid. Musc. Recent. Suppl. 1: 176. 1806.

Dicranum sulcatum Kindb.; Macoun, Bull. Torr. Club. 17: 87. 1890.

Dicranum crispulum C. M. & Kindb.; Macoun, Cat. Can. Pl. 6: 27. 1892.

Dicranum leucobase C. M. & Kindb. l. c. 30. 1892.

Dicranum trachyphyllum R. & C. Bot. Gaz. 22: 48. 1896.

Dicranum campthophyllum Kindb. Eur. & N. Am. Bryin. 193. 1897.

♂ plants mingled with the ♀ and nearly as large, both in soft dull- to yellowish-green sods; stems 2–8 cm. long, tomentose below; stem leaves more or less falcate-secund, crisped when dry, especially the upper ones, up to 7 mm. long, from a broadly lanceolate base gradually narrowed to a long slender, flexuous grooved or subtubular upper portion; upper margin from nearly entire to strongly toothed, more or less incurved, sometimes bistratose; costa $\frac{1}{6}$ – $\frac{1}{4}$ the width of the leaf at base, excurrent, toothed on the back above; alar cells larger and inflated, usually brown; cells above these rectangular, 8–10 μ wide by 40–80 μ long with pitted or unpitted walls; upper leaf cells 6–7 μ wide, quadrate, rectangular or irregular with sharp angles, walls not pitted, smooth to spinose-papillose on the back; perichaetial leaves convolute at base, the inner abruptly narrowed to a slender costate subula denticulate at apex. Seta solitary, yellowish, 1.5–2 cm. long; capsule brown to yellow, oblong to cylindric, inclined, unsymmetric to arcuate, 2–3 mm. long, furrowed when dry; operculum long-rostrate, often nearly as long as the urn; annulus narrow; peristome teeth red, vertically striate, split about half way; spores about 18–24 μ in diameter, mature in autumn. Type locality, Scotland.

ILLUSTRATIONS:—Braithw. Brit. Moss. Fl. 1: pl. 22D; M. H. M. figs. 42, 44; pl. 46.

EXSICCATI:—Drumm. Musc. Am. 82; Sull. Musc. Allegh. 157, 158; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 157, 158, (Ed. 2) 64, 80; Aust. Musc. Appal. Suppl. 472; R. & C. Musc. Am. Sept. 8; Grout, Musci Perf. 40; Holz. Musc. Acro. Bor. Am. 33, 486, 653; Allen, Mosses Cascade Mts. 9; Baker, Pacific Coast Bryophytes 585, 587.

On decayed wood, soil and bases of trees in cool moist woods in mountain regions; Labrador to S. Carolina, west to Alaska and California; common in mountains of N. England and N. Y.

Dixon, Handbk. Brit. Mosses 114, says of this species "A very difficult and variable species; the leaves may be smooth or highly papillose, entire at margin or closely denticulate; the fruit varies in color, in the amount of striation, in direction, and in form from broadly ovate to narrowly cylindric."

6a. Var. CONGESTUM (Brid.) Husnot. Musc. Gall. 34. 1884.

Dicranum congestum Brid. Sp. Musc. 1: 176. 1806.

Leaves broader, more shortly pointed, faintly or not at all papillose at back; costa narrower, $\frac{1}{6}$ – $\frac{1}{9}$ width of leaf base, percurrent to shortly excurrent; upper leaf cells longer, larger, sinuately elliptic-rhomboid.

Holzinger's 610, issued as *D. congestum*, I cannot differentiate from *fuscescens*, but specimens collected by me in and around Tolland, Colorado in 1914 and a specimen in Canadian National Museum, Macoun,

Kicking Horse Lake as *D. algidum subspadiceum* Kindb. seem to be enough different to place in this variety, which probably occurs elsewhere in the Rocky Mts.

The *D. fuscescens* of the Rocky Mts. and westward seems to be larger than that from the eastern U. S., also to have the leaves more strongly falcate-secund and less crispate.

7. DICRANUM MUHLENBECKII Bry. Eur. fasc. 37-40. pl. 78. 1847.

Dicranum Rauai Aust. Bot. Gaz. 1: 28. 1876.

Subspecies of *D. fuscescens*, with which it is compared below. Plants larger on the average, growing in dense tomentose sods; leaves erect and nearly equally spreading when moist, more or less crisped when dry, 4-6 mm. long, subtubulose above by the inrolled margins, serrate to nearly entire above, apex broader, acute; costa percurrent to slightly excurrent, at least 1/6 width of leaf base; basal cells above the inflated alar rectangular, averaging shorter but not always shorter in any two given specimens (one from each species) somewhat porose; upper cells more irregular, quadrate, triangular, rhomboidal, rectangular, etc., not porose 10-12 μ wide; perichaetial leaves with shorter subula. Capsule cylindric, up to 4 mm. long, somewhat arcuate, typically almost erect and much less striate, 4-6 : 1; spores summer to autumn. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. l. c.; M. H. M. pl. 16.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 65, (Ed. 2) 81; Grout, Musci Perf. 259 (as *D. fuscescens*).

Typical plants as described above are very distinct from the ordinary run of *D. fuscescens*, but there are all sorts of intergrading forms, some of which are almost impossible to place accurately.

On rocks and soil, occasionally on decaying wood; New England and Ontario to Alaska; south to New Jersey and New Mexico. Alpine and depauperate forms grade into

7a. Var. BREVIFOLIUM Lindb. Bot. Not. 1865: 80. 1865.

Leaves shorter and broader in apical region, incurved to strongly crisped; lower leaf cells narrower, up to 12 μ wide at most; capsules 2.5-3 : 1. Alaska to British Columbia. Holz. Musc. Acro. Bor. Am. 560, from Pikes Peak, Colorado is near this variety, but the lower leaf cells are too wide to be typical.

Easy to confuse with *D. condensatum* and its thicker costa and less xerophytic habitat seem the best means of distinction in critical cases, especially of sterile plants. The difference in size of leaf cells as described by Limpricht and Williams does not seem to hold.

I cannot follow Williams in his treatment of *D. brevifolium* in N. Am. Flora 15²: 124. I have examined the specimens he has named *brevifolium* in the herbarium of The New York Botanical Garden and he seems to have transferred to *brevifolium* most of the plants previously named *Muhlenbeckii*.

8. DICRANUM BERGERI Bland. Musci Frond. Exs. no. 114. 1805; Bot. Zeit. Regensb. 5: 52. 1806.

Dicranum Schraderi Web. & Mohr. Bot. Tasch. 177. 1807.

Dicranum stenodictyon Kindb.; Macoun, Bull. Torr. Club. 16: 92. 1889.

Dicranum rugosum Kindb. Ottawa Nat. 4: 61. 1890.

Dicranum undulatum Schrad. Spic. Fl. Germ. 59. 1794 & Brid. Sp. Musc. 1: 76. 1806. (not of Ehrh.).

Plants in deep dense sods, dull- to yellowish-green; stems tomentose, up to 15 cm. in length; leaves crowded, erect to slightly spreading, hardly secund, little changed in drying, but somewhat flexuose; 6-7 mm. long, from an oblong or lanceolate base gradually narrowed to the wavy channelled slender point, base slightly wider just above the insertion, typically rounded-obtuse at the apex, but sometimes obtusely acute, more or less serrulate above, typically smooth at the back above but sometimes with a few small teeth, or large papillae; costa typically ending below the apex, but sometimes percurrent in some of the leaves; costa rather narrow, toothed above on the back, rarely nearly smooth; alar cells colored and inflated; lower leaf cells thick-walled and pitted, linear, about 8 μ wide, 60-80 μ long; upper cells shorter, 1-3 : 1, irregular (quadrate, triangular, rounded-rectangular), usually a few longer near the apex; inner perichaetial leaves shorter, from a convolute-sheathing base abruptly narrowed to a slender subula. ♂ plants minute, attached to the tomentum of the ♀; seta solitary, pale, yellowish to orange, 3-4 cm. long; capsules arcuate-cylindric, cernuous, lightly striate when dry and empty; urn 2.5-3.5 mm. long, not strumose; operculum

long-rostrate, annulus of 2-3 rows of cells; peristome teeth somewhat irregularly divided into two, sometimes 3 or even 4 prongs, strongly papillose throughout, lightly striate below; spores slightly rough, 15-21 μ in diameter, mature in summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl.* 80; Braithw. Brit. Moss. Fl. 1: *pl.* 22B; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 14B; *Pl.* 46.

EXSICCATI:—Drumm. Musc. Am. 87, 88; Sull. Musc. Allegh. 163; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 67, (Ed. 2) 84; Aust. Musc. Appal. 93; R. & C. Musc. Am. Sept. 12; Holz. Musc. Acro. Bor. Am. 533, a poor depauperate form. His 130 is, I think, *D. Drummondii*. Austin's 93 & 94 approach *Drummondii*.

In bogs and meadows in cold situations, largely alpine and arctic; Labrador to Alaska, southwards to New Jersey, Ohio and Colorado.

This species seems to grade into *D. Drummondii*, especially forms with acute leaves and percurrent or short-excurrent costa. For distinctions see that species.

The pitting of the walls of the basal cells varies a great deal even in the same plant. Apparently it is greatest in the older leaves, but more apparent in *Bergeri* than in *Drummondii*.

9. DICRANUM DRUMMONDII C. Muell. Syn. 1: 356. 1848.

Dicranum undulatum var. Hook. in Drumm. Musc. Am. 86. 1828.

Differs from *D. Bergeri* as follows; leaves reaching 9 mm. long, narrowly acute, spreading-flexuous when moist, more or less secund and crispate when dry, more strongly serrate above; leaf blade and costa more strongly roughened on the back above; basal leaf cells less pitted; costa papillose on the back to nearly the middle, percurrent or excurrent. Setae usually aggregate, 1-4 from a single perichaetium. Type locality, North America.

ILLUSTRATIONS:—Sull. Icones Musc. Suppl. *pl.* 33; *Pl.* 48, 50.

EXSICCATI:—Drumm. l. c.; Sull., & Lesq. Musc. Bor. Am. (Ed. 1) 69b, (Ed. 2) 88; Holz. Musc. Acro. Bor. Am. 131, 130 (as *D. Bergeri*), 432; Aust. Musc. Appal. Suppl. 474.

On soil in cool shaded moist places; Maine to Manitoba and Montana; south to New Jersey and Colorado.

When in good fruit the clustered capsules are distinctive, but often only single and solitary capsules are found; when dry the crispate leaves distinguish from *Bergeri*, but when moist this distinction is not obvious; the rougher and more slender pointed leaves will usually serve for identification. There are cases, particularly in the case of poorly developed plants, that can hardly be distinguished.

Williams, N. Am. Flora 15²: 122 compares this with the European *D. elatum* Lindb. *D. rugosum* is distinguished by the more strongly undulate non-crisped leaves and the elongated porose upper leaf cells.

The more slender undulate leaves and darker color distinguish from *D. fuscescens* var. *congestum*, which is found in more xerophytic conditions. The pitting of the walls of the basal cells varies a great deal even on the same plant, and is apparently greater in the older leaves, but in general less developed in *D. Drummondii* than in *D. Bergeri*.

10. DICRANUM CONDENSATUM Hedw. Sp. Musc. 139. *pl.* 34. 1801.*

Dicranum pallidum Bry. Eur. fasc. 37-40. 1847, not of Web. & Mohr, 1807.

Dicranum spurium condensatum Lesq. & James Man. 76. 1884.

Dicranum sabuletorum R. & C. Bot. Gaz. 14: 91. *pl.* 12A. 1889.

Plants in compact radiculose sods, green to yellow-green; stems about 2 cm. long rarely up to 4 cm.; leaves erect-spreading when moist, and scarcely secund and nearly straight, when dry more or less flexuose to crispate, sometimes undulate, oblong-lanceolate, gradually narrowed to a channelled acute apex, 4-6 x 0.75-1 mm., smooth or somewhat papillose at back above; costa 80-100 μ wide, 1/8-1/10 width of leaf at base, percurrent to slightly excurrent, sometimes nearly smooth at back but usually toothed and more or less papillose, in cross section with 7 or 8 median guide cells with well developed stereid bands above and below; upper leaf cells short, angular, irregular, 1-1.5 : 1, averaging about 8 μ wide near the middle; the lower linear to elongate-rectangular, with walls more or less pitted; alar cells inflated, usually golden-brown; perichaetial leaves shorter, from a broad convolute-sheathing base abruptly narrowed to a slender, linear, smooth or denticulate subula. ♂ plants attached to the tomentum of the ♀; seta solitary, yellow, 2-3 cm. long; capsule pale, 2 mm. or less long, oblong to short-cylindric, unsymmetric to arcuate, inclined to cernuous, sometimes slightly strumose, somewhat furrowed when dry; operculum obliquely long-rostrate; annulus distinct; peristome teeth dark-reddish, usually divided more than 1/2 the way down into 2-3 prongs, longi-

* See Williams' note in N. American Flora 15²: 123.

tudinally striate on the outer face, papillose above; spores slightly rough, up to 22 μ , mature in spring. Type locality, Lancaster, Pennsylvania.

ILLUSTRATIONS:—Hedw. l. c.; Bot. Gaz. l. c.; M. H. M. 103, f. 45.

EXSICCATI:—Sull. Musc. Allegh. 160; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 68, 68b, (Ed. 2) 85, 86; Holz. Musc. Acro. Bor. Am. 54.

On dry sandy soil, Nova Scotia to Florida; west to Wisconsin, Missouri, and Texas; very common in the New Jersey Pine Barrens. Distinguished from *D. Muhlenbergii* by the characters noted in the key and from *D. spurium* in the narrower, scarcely undulate leaves, much less strongly papillose above on the back.

11. DICRANUM SPURIUM Hedw. Sp. Musc. 141. 1801; Stirp. Crypt. 2: 82. pl. 30. 1789.

Dicranum brachycaulon Kindb.; Macoun, Cat. Can. Pl. 6: 34. 1892.

Plants robust, 2–4 cm. high, rarely more, yellowish-green, loosely tufted, mostly interruptedly foliate; leaves loosely imbricate, up to 6.5 mm. long, incurved and crispate in the upper portion when dry, strongly rugose-undulate, subtubulose above, ovate to ovate-lanceolate below, notably widest some distance above the base, rapidly narrowed to the narrowly lanceolate upper portion, broadly acute, serrate above on the margin and back of costa, densely papillose on the back about $\frac{1}{2}$ the way down; costa rather narrow, $\frac{1}{7}$ – $\frac{1}{10}$ the leaf width at the broadest part, nearly percurrent; alar cells inflated, hyaline or colored, often bi-tri-stratose; lower leaf cells elongated-rectangular to linear, with porose walls, soon changing to the irregular angular upper cells which are triangular, quadrate, or even transversely elongate, 8–10 μ wide with thick irregular, non-pitted walls, the marginal more elongate; perichaetial leaves broadly convolute-sheathing at base, abruptly narrowed to a rather short, linear, nearly smooth upper portion. Antheridial plants minute, often scarcely 1 mm. high, attached to the tomentum of the female plants; setae slender, solitary, yellowish to red, 2–3 cm. long; capsule light colored, subcylindric, arcuate and inclined, irregularly sulcate and contracted under the mouth when dry and empty, about 2 mm. long, often somewhat strumose; operculum obliquely rostrate, about as long as the urn; peristome teeth red, vertically striate, divided about $\frac{1}{2}$ the way into 2 or 3 prongs; annulus distinct; spores somewhat rough, up to 20 μ in diameter, mature in spring. Type locality, Germany.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. pl. 81; M. H. M., f. 45; pl. 46.

EXSICCATI:—Drumm. Musc. Am. 90, Musc. Am. S. States 47; Aust. Musc. Appal. 95; Holz. Musc. Acro. Bor. Am. 228, 228b.

On rather dry sandy soil or rocks in shaded places, rather infrequent and fruiting rather infrequently; Newfoundland to the Lake Superior Region, south to Tennessee and Missouri.

Distinct from the related species by the thickly papillose back of the upper portion of the leaves.

12. DICRANUM FRAGILIFOLIUM Lindb. Oefv. Sv. Vet.-Akad, Förh. 14: 125. 1857.

Plants slender, in compact green sods; stems 1–13 cm. long, tomentose; leaves erect-open when moist, when dry more erect, nearly straight, with brittle points mostly broken, narrowly lanceolate, 6–7 mm. long, gradually narrowed to a long slender apex, usually entire but occasionally serrulate above and less attenuate, the channelled upper portion consisting chiefly of the excurrent costa, which is $\frac{1}{4}$ – $\frac{1}{3}$ the width of the lower part of the leaf and nearly or quite smooth in the excurrent portion; inflated alar cells brown or hyaline, usually extending to the costa; lower leaf cells elongate, mostly rectangular, sometimes pitted, becoming increasingly shorter above, not pitted, thick-walled and rounded, in the upper lamina 1–2 : 1, about 8 μ wide; perichaetial leaves from a broad convolute-sheathing base abruptly narrowed to a slender, nearly smooth point about as long as the clasping base. Male plants slender, in the tomentum of the upper fertile stems, up to 6 mm. long; seta 1.5–2 cm. long, yellow, turning reddish with age; capsule about 2 mm. long, oblong to ovoid, curved and inclined, furrowed when dry, not strumose; annulus distinct; operculum conic-rostrate, about the length of the urn; peristome teeth brownish-red, longitudinally striate; spores up to 25 μ , ripe in summer. Type locality, Sweden. Pl. 47.

EXSICCATI:—Macoun, Can. Musci 22a.

On decaying wood; Labrador to Alaska, south to Minnesota,* Montana, Washington and Oregon.

Rarely fruiting and probably reproducing by the broken leaf tips.

Sterile plants distinguished from *D. strictum* by the broader costa, alar cells reaching costa in most cases and upper cells shorter, thicker-walled and more rounded at the ends. *D. fulvum viride* is distinguished

* The Minnesota plants collected by Holzinger and determined by Bryhn, have leaves serrulate near the apex and costa shortly excurrent; they are doubtfully this species.

from both by the shorter quadrate upper leaf cells. Brotherus (Laubm. Fennoskand. 96) states that the costa in this species has no stereid bands; Williams (N. Am. Flora 15³: 126) states that it has one on each side of the guides.

13. DICRANUM ELONGATUM Schleich.; Schwaegr. Suppl. 1¹: 171. 1811.

Dicranum sphagni Wahlenb. Fl. Lapp. 337. 1812.

Dicranum subflagellare Card. & Thér. Proc. Wash. Acad. Sci. 4: 298. 1902.

Plants in dense compact sods; stems up to 15 cm. long, tomentose, slender; leaves erect-appressed to incurved when dry, the uppermost sometimes contorted, 3-4 mm. long, from a lanceolate base gradually narrowed to a subtubulose or channelled acute point, entire or slightly serrulate at apex; costa $\frac{1}{8}$ - $\frac{1}{4}$ the width of the leaf at a point a little above the base, percurrent to shortly excurrent; alar cells usually colored; lower cells elongate, linear, incrassate, more or less pitted near the base, becoming shorter 1-2 : 1, rounded, and not pitted in the upper lamina. Seta about 1.5 cm. long; capsule small, about 1.5 mm. long, slightly inclined and curved, somewhat furrowed when dry; annulus well developed, operculum long-rostrate, about as long as the urn; peristome teeth dark-red, longitudinally striate; spores up to 24 μ , mature in late summer. Type locality, France.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. 1: pl. 23A; Dixon, Handb. Brit. Mosses pl. 15A; Pl. 44 & 48.

EXSICCATI:—Drumm. Musc. Am. 91, 92; R. & C. Musc. Am. Sept. 91, 92; Holz. Musc. Acro. Bor. Am. 559, 633.

On rocks and soil; Greenland to Alaska; south to the mountains of Montana and New England.

D. sphagni is regarded by Brotherus as a variety.

The small capsules (2 mm. long or less) of the arctic-alpine species *fragilifolium*, *laevicens*, *elongatum* and *groenlandicum* when present, set them off from the related species.

14. DICRANUM SPADICEUM Zett. Musc. Pyren. 30. 1864, and K. Sv. Vet.-Akad. Handl. 5: 20. 1865.

Dicranum neglectum Jur.; Milde in Beilage Bot. Zeit. 1864 and Laubm. 47. 1882.

Dicranum algidum Kindb. Rev. Bryol. 23: 17. 1896 (*vide* Williams).

Plants in compact dark-green sods, sparingly tomentose, 4-5 cm. high; stem leaves erect-spreading, when dry laxly appressed and often somewhat contorted, 3.5-5 mm. long, from a broadly lanceolate base gradually narrowed to a tubulose subulate upper portion, usually smooth, sometimes slightly toothed on the margins and somewhat rough on the back; costa percurrent or slightly excurrent, smooth or somewhat roughened at the apex, *about 1/9 the width of the leaf at the broadest part*; alar cells well differentiated and inflated, usually colored, not extending quite to the costa; cells of the lower leaf much as in *scoparium*; the upper becoming as broad as long in part, very irregular and rounded, usually not pitted; inner perichaetial leaves from a convolute-clasping base abruptly narrowed to a slender, smoothish point a little shorter than the base. Seta yellowish to orange, 1.5-2 cm. long; capsule 2-2.5 mm. long, arcuate-cylindric, when dry furrowed, not strumose; annulus distinct; peristome teeth vertically striate except when old; spores up to 20 μ , mature in late summer. Type locality, mountains of the southern Tyrol, Austria. Pl. 47.

EXSICCATI:—E. & A. Nelson, Plants of Yellowstone National Park 5396.

On wet rocks at high altitudes and latitudes, rare; Alaska south to Oregon, Montana and Wyoming.

Distinguished from *D. elongatum* by the relatively much narrower costa.

15. DICRANUM GROENLANDICUM Brid. Musc. Recent. Suppl. 4: 68. 1819.

Dicranum labradoricum C. Muell. Syn. 1: 366. 1848.

Dicranum tenuinerve Zett. Sv. Vet.-Akad. Handl. II. 13¹³: 14. 1876.

Dicranum Macounii Aust. Bot. Gaz. 2: 96. 1877.

Differs from *D. elongatum* in the broader, narrowly *obtus*, usually smooth and entire leaves with a narrower costa ($1/8$ - $1/10$ width of leaf base), more strongly tubulose above; *leaf cells pitted to well above the leaf middle*. Capsules nearly erect and symmetric.

ILLUSTRATIONS:—Bry. Eur. pl. 76 (according to Williams, N. Am. Flora 15³: 127); Pl. 47.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 63, 79; R. & C. Musc. Am. Sept. 6, 6b.

In bogs and wet places; circumpolar; south to the mountains of New England; apparently common in the far north. Distinguished from *D. laevicens* by the shorter leaf cells of the upper lamina, the more erect capsules and more strongly striate peristome teeth.

16. DICRANUM LAEVIDENS Williams, N. Am. Flora 15²: 126. 1913.

Plants in wide compact sods, glossy, brownish-green except at the growing tips; stems 7-8, rarely 15 cm. long, rather slender, tomentose; leaves little changed in drying, nearly straight, erect spreading in all directions, 5-6 x 1 mm. from an ovate-lanceolate base rather gradually narrowed to a nearly tubulose smooth upper portion, with apex typically *narrowly rounded-obtuse with short cells*; costa 1/8-1/10 the width of the leaf base, ending in or below the leaf apex, smooth throughout, in a median cross-section with 5 or 6 guide cells and a stereid band of one or two rows of cells above and below; inflated alar cells reaching nearly to the costa, other cells elongate almost to the apex, the median sublinear with strongly pitted walls, 8-10 x 40-60 μ , the upper much shorter and less pitted, 2-4 : 1; inner perichaetial leaves scarcely as long as the stem leaves, convolute-clasping at base, rather abruptly narrowed to a linear entire subula up to 2 mm. long; seta yellowish to reddish, 2.5-3 cm. long; capsule oblong, inclined, slightly curved and unsymmetric, about 2 mm. long, furrowed when dry, not strumose; annulus large; operculum long-rostrate, with an oblique beak about the length of the urn; peristome teeth reddish, divided (sometimes irregularly so) more than 1/2 the way down "neither distinctly vertically striate nor papillose;" calyptra 4 mm. long, smooth; spores 20-24 μ in diameter, mature in summer. Type collected on the Klondike River near the mouth of Bonanza Creek, 3 miles from Dawson, Yukon, July 23, 1899 (Williams 539). Type in herb. N. Y. Botanical Garden, seen and studied. *Pl.* 47.

In wet swampy places, Dawson; Quinhagak, Alaska (Stecker); Hudson Bay (Comer); N. W. Greenland (Hovey).

The striking thing about the leaf structure is the blunt entire apex with short cells like those in the apex of *Leptodictyum riparium obtusum*. Much the same sort of apex is found in the narrower leaves of *D. groenlandicum*, but in that species all the leaf cells of the narrower leaves are much more incrassate. In a peristome from the type material the middle plates of the teeth were plainly striate on the outside and the points of the prongs papillose. Occasional plants of *D. scoparium* and *D. Bonjeani* have similar, but wider, leaf apices on the upper portion of the new shoots, but in these the lower leaves are normal. *D. angustum* Lindb. Meddel. Soc. Fl. Fenn. 252. 1881, has narrower-pointed, acute leaves, more or less toothed at the apex. It is very doubtfully American, though *D. laevidens* might possibly better be regarded as a variety of *D. angustum* with blunt leaves, smooth and entire at apex, and with teeth little striate. *D. laevidens* is distinguished from *D. groenlandicum* by the much more elongated upper leaf cells. Williams' Lake Linden plants referred to *laevidens* are very close to *angustum*. (See *Pl.* 48.)

17. DICRANUM ARCTICUM Schimp. Bry. Eur. Suppl. Fasc. 3-4. *pl.* 3. 1866.

Dicranum Starkei var. *molle*. Wilson, Bry. Brit. 74. 1855.

Dicranum glaciale Berggr. Act. Univ. Lund. 2¹: 19. f. 1-9. 1866.

Plants in wide deep tufts, 5-12 cm. high, yellowish- to olive-green above, brown below; stems not radiculose except at base, mostly slender and simple; leaves straight, and erect-open or somewhat curved toward the summit of the stem, 4-6 mm. long, subtubulose above, from an ovate- or oblong-lanceolate base gradually narrowed to a slender subulate upper portion, entire or nearly so; costa shortly excurrent, about 1/10 the width of the leaf base, in cross section with the median row of 4-7 guide cells rather less strongly differentiated than in most species; alar cells strongly inflated, not reaching the costa, usually colored; other cells linear, with thick walls more or less pitted in the lower portion, shorter above, the median about 6 x 40-60 μ ; perichaetial leaves, from a clasping ovate base abruptly narrowed to a slender nearly smooth point of about an equal length. *Autoicous*; ♂ flower close to the ♀; seta about 1.5 cm. long, rarely longer; capsule about 2 mm. long, oblong-cylindric, inclined and curved, in most cases distinctly striate and strumose when dry; annulus well developed; operculum obliquely rostrate; peristome teeth longitudinally striate below, papillose above; spores about 16 μ , mature in summer. Type locality, Norway.

ILLUSTRATIONS:—Bry. Eur. 1. c.; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 13H; *Pl.* 43.

On moist rocks and soil, Greenland, Labrador and the Yukon.

This arctic-alpine species resembles exaggerated *Arctoa Starkei*, and its autoicous inflorescence also indicates a relationship to *Arctoa*, but the large size, presence of guide cells in the costa and the pitted leaf cells ally it with *Eudicranum*. It is obviously an intermediate form, as *D. rhabdocarpum* is a form intermediate between *Orthodicranum* and *Eudicranum*.

18. DICRANUM RUGOSUM (Hoffm.) Brid. Sp. Musc. 1: 175. 1806.

Dicranum polysetum (Sw.) Schwaegr. Suppl. 1¹: 165. *pl.* 47. 1811.

Dicranum undulatum (Ehrh.) Sturm, Deutsch. Fl. 2: 10. 1812?

Plants tall, up to 25 cm. and robust, growing in loose wide mats, densely radiculose, bright glossy yellow-green; *leaves strongly undulate*, long-lanceolate, up to 10 x 1.5 mm., *spinously serrate in the upper half*, spreading-flexuous, margins slightly recurved below; costa strong but relatively narrow, vanishing in the apex or slightly below, with *two sharply toothed lamellae on the back above*; alar cells distinctly differentiated, colored, scarcely reaching the costa; other leaf cells elongate and porose, median about 12 x 40-60 μ , the upper smaller, all smooth. Setae aggregate, 1-7 in a perichaetium, yellowish or reddish, 2-4 cm. long; capsule arcuate-cylindric, cernuous, 2-3 mm. long, somewhat furrowed and slightly contracted under the mouth when dry and empty, not strumose; annulus lacking; operculum obliquely rostrate, fully as long as the urn; peristome teeth finely striate vertically, deeply divided, sometimes irregularly into 3 prongs, and papillose on the margins and prongs; spores about 18-24 μ , mature in late summer. Type locality, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl.* 82, 83; M. H. M. f. 46; Mosses w. H.-lens *pl.* 21; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 131; *Pl.* 43.

EXSICCATI:—Drumm. Musc. Am. 85; Sull. Musc. Allegh. 156; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 69, (Ed. 2) 87; Aust. Musc. Appal. 97; Holz. Musc. Acro. Bor. Am. 134, 589.

On moist shaded soil in cool places; Newfoundland to British Columbia; south to Oregon, Minnesota, Ohio and W. Virginia.

19. DICRANUM MAJUS Smith, Fl. Brit. 1202. 1804.

Plants like an exaggerated *D. scoparium*; *leaves very long, up to 15 mm.*, strongly and regularly falcate-secund, scarcely altered when dry, toothed on the margins and back above; costa about 1/12 the width of the leaf base, strongly toothed on the back above but hardly lamellate; *lower leaf cells very incrassate and porose*, lumen hardly twice the thickness of the cell wall. Setae aggregate, 2-5 from a single perichaetium (occasionally single); operculum fully as long as the urn. Type locality, England.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. 1: *pl.* 20E; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 14F; *Pl.* 46.

EXSICCATI:—Macoun, Can. Mosses 35.

In woods; Greenland to Maine and in Alaska.

In fruit, the aggregate setae easily distinguish it from *scoparium*, the non-undulate leaves from *Drummondii* and *rugosum*.

19a. Var. ORTHOPHYLLUM A. Br.; Milde, Bryol. Siles. 71. 1869.

Leaves nearly straight. Holz. Musc. Acro. Bor. Am. 278 from New Brunswick; according to Williams this is frequent in Alaska.

20. DICRANUM SCOPARIUM [L.] Hedw. Sp. Musc. 126. 1801.

Dicranum pallidum C. Muell. Syn. 1: 359. 1848. (not of Web. & Mohr, 1807.)

Dicranum mexicanum Schimp.; Besch. Mém. Soc. Nat. Cherbourg 16: 164. 1872.

Dicranum Howelii R. & C. Bot. Gaz. 14: 93. *pl.* 12B. 1889.

Dicranum angustifolium Kindb.; Macoun, Bull. Torr. Club 17: 86. 1890.

Dicranum canadense Kindb. l. c. 87. 1890.

Dicranum Kindbergii Paris, Index. Bryol. (Ed. 1) 356. 1895.

Dicranum scopariforme Kindb. Eur. & N. Am. Bryin. 193. 1897.

Plants large, up to 10 cm., in wide glossy yellow-green sods, rather loosely tufted and tomentose; leaves typically strongly falcate-secund, not undulate (with rare exceptions), narrowly lanceolate-subulate, sub-tubulose above, up to 9 mm. long, strongly serrate above on the long narrow subula, little changed in drying, lamina smooth on the back; costa ending in the apex or shortly excurrent, bearing on the back above 2-4 more or less prominent serrate lamellae or ridges, rarely nearly smooth; leaf cells all elongate and more or less porose, the lower oblong to rectangular, linear at the margin, shorter and less porose above; alar cells inflated and usually colored, rarely extending to the costa; perichaetial leaves sheathing at base, gradually to abruptly narrowed to a long linear subula, which is usually toothed. ♂ plants minute often attached to the tomentum of the ♀ and sometimes appearing as if attached to the stem itself. Setae solitary, yellowish to reddish-brown, 2.5-3 cm. long; capsule arcuate-cylindric, 3-4 mm. long, brown, inclined, typically smooth but occasionally somewhat furrowed when dry and empty, but not contracted under the mouth; operculum long-rostrate, rather more than 1/2 the length of the urn; annulus wanting; peristome teeth red-brown, typically striate longitudinally and divided into 2, rarely 3 papillose prongs, at least 1/2 the way down; spores slightly rough, up to 24 μ , mature late summer to autumn. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl.* 74, 75; Braithw. Brit. Moss Fl. 1: 21A; Jennings, Mosses W. Pa. *pl.* 8; M. H. M. *figs.* 42, 43 & 44; *Pl.* 46.

EXSICCATI:—Drumm. Musc. Am. 80; Sull. Musc. Allegh. 155; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 59, 60, 61, 62, (Ed. 2) 75, 76, 77, 78; Macoun, Can. Musci 36, 37; Holz. Musc. Acro. Bor. Am. 7: 55, 176, 611; Allen, Mosses Cascade Mts. 8a, 8b (var. *sulcatum*) Grout, Musci Perf. 5.

On soil, rocks and decaying wood in shaded places, very common and almost universal in the temperate Northern Hemisphere.

Exceedingly variable in almost every character, even in plants in the same tuft and leaves on the same plant. Most descriptions describe the costa as not quite percurrent, but in most vigorous specimens the apical lamina is undemonstrable to the author; the leaf cells vary immensely in length and porosity and the leaves at times are almost straight and only slightly toothed at the back. These variations have given rise to the naming of various varieties and subspecies. *D. consobrinum* R. & C. Bot. Gaz. 15: 39. *pl.* 35B is a form in which the inner perichaetial leaves are emarginate and with subula very short or wanting; the male plants are said to be attached to the female. Some of the perichaetial leaves are as described by the authors, but others from the type collection have normal perichaetial leaves.

In the form described as var. *sulcatum* R. & C. Bot. Gaz. 14: 92. 1889, the seta is pale yellow and the capsules deeply furrowed when old. *D. Howellii* is a western form with perichaetial leaves gradually narrowed into a long serrate upper portion. In some specimens the basal leaf cells are about $12 \times 45-80 \mu$ and strongly porose; upper cells markedly porose and about $3-5 : 1$, these seem to be high altitude forms. Other plants have the basal cells $52-105 \mu$ long and sparingly porose; the upper $3-5 : 1$ and scarcely porose or pitted. These latter usually have narrower apices than the former.

In some specimens the leaves may be slightly crisped, in others almost straight.* High altitude and latitude plants present numerous of these puzzling variations. The form with straight leaves seems common in the southern Appalachians. Peristomes of old deoperculate capsules sometimes fail to show the striations. Macoun's 36 has short capsules only slightly inclined and nearly symmetric but otherwise matches *D. scoparium*. There are many forms approaching subspecies *Bonjeani* and intermediate between the two, so that it is often a matter of opinion as to which species a given plant is to be referred.

21. DICRANUM BONJEANI DeNot. in Lisa, Elen. 29. 1837.

Dicranum palustre Bry. Eur. fasc. 37-40. *pl.* 79. 1847.

Dicranum diptoneuron C. Muell. Flora 70: 221. 1887.

Dicranum leioneuron Kindb.; Macoun, Bull. Torr. Club 16: 92. 1889.

Dicranum congestiforme C. M. & Kindb.; Macoun, Cat. Can. Pl. 6: 29. 1892.

Dicranum plano-alare C. M. & Kindb.; Macoun, l. c. 31.

Dicranum undulifolium C. M. & Kindb.; Macoun, l. c. 32.

Dicranum subpalustre C. M. & Kindb.; Macoun, l. c. 33.

Dicranum Roellii Kindb.; Röhl, Hedwigia 35: 60. 1896.

Dicranum hyalinum Kindb. Röhl. l. c. 61.

Dicranum perichaetiale Kindb.; Röhl l. c. 61.

Dicranum alatum Card. & Thér. Bot. Gaz. 37: *pl.* 17. 1904.

Subspecies of *D. scoparium*, from which it typically differs in the erect-spreading leaves, little changed when dry, sometimes undulate but rarely much curved, broadly acute to obtuse at the apex, margin and back of costa often little or not at all toothed; upper leaf cells usually more strongly pitted; capsule more frequently striate. Type locality, Italy.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. 1: *pl.* 22B; M. H. M. *f.* 44; *Pl.* 46.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 66, (Ed. 2) 83; Aust. Musc. Appal. 92; Holz. Musc. Acro. Bor. Am. 354, 334, 133 as *D. scoparium orthophyllum*, a form with very serrate leaves toothed on back of costa, 262 as *D. Bergeri* f. *compacta* is much the same thing; in this the upper leaf cells are not at all those of *D. Bergeri*.

D. alatum (*D. Bonjeani* var. *ALATUM* Barnes, Bot. Centralb. 44: 386. 1890), has the blunt leaves and short pitted upper leaf cells of *Bonjeani* with the second leaves sharply serrate and toothed on the back of the costa as in *scoparium*. Holz. Musc. Acro. Bor. Am. 205 and 390. There are also similar forms with non-second leaves as in Holzinger's 7 and 262. It is really a form intermediate between *scoparium* and *Bonjeani*. Holzinger's 206, *D. scoparium* f. *fragilis*, has the young upper leaves narrowly obtuse, entire and smooth on the back, but the older leaves are typical *Bonjeani*. Macoun's 49, from Victoria, Vancouver Island, his 27a, as *D. subscoparium*, from Laggan, Rocky Mts., Alberta, as well as plants collected by Cooper near the Stickine Glacier, have leaves of much the same sort as Holzinger's 206.

* Var. *orthophyllum* Brid. = *D. subspadiceum* Kindb. Eur. and N. American Bryin. 199. 1897.

DOUBTFUL AND EXCLUDED SPECIES.

Dicranum Sendtneri Limpr. Laubm. 1: 360. 1886. This is credited to Arctic N. America by Brotherus (Engler & Prantl, Laubm. (Ed. 2) 1: 206). Of it the author says that it is one of the several forms intermediate between *D. fuscescens* and *D. elongatum*, yet nearer *D. fuscescens*, from which he has hesitated for a long time to separate it. To my mind there are too many species of arctic *Dicrana* recognized in this group. According to Limpricht's key it is distinguished from *D. elongatum* by the narrower costa, $1/7$ the width of the leaf base, and the oblong upper cells, which last distinguishes it from *D. fuscescens*. Without seeing the type specimen it would be difficult to place this doubtful species.

The following are quoted from N. Am. Flora 15²: 13.

Dicranum caespitans Schimp.; Besch. Mém. Soc. Sci. Nat. Cherbourg 16: 164. 1872, is *Dicranella subinclinata*.

Dicranum Demetris R. & C. Bot. Gaz. 22: 48. 1896, is *Oncophorus Wahlenbergii*.

Dicranum Pittieri R. & C. Soc. Bot. Belg. 31¹: 146. 1893, is *Dicranodontium costaricense*.

Dicranum sublongisetum C. Muell. Bull. Herb. Boiss. 5: 185. 1897, is *Dicranodontium longisetum*.

Dicranum subulifolium Kindb.; Macoun, Bull. Torr. Club. 17: 87. 1890. This is a rather doubtful species. There are no specimens from the type locality, Cedar Hill, Vancouver Island, either in the collections at Ottawa or in the herbarium of the New York Botanical Garden, but under this name occur in the Macoun collections, no less than five species, as follows, *D. fragilifolium*, *D. groenlandicum*, *D. elongatum*, *D. Bergeri*, and *D. flagellare*.

11. DICRANODONTIUM Bry. Eur. fasc. 41. 1847.

Plants usually in compact tufts; stems slender, tomentose, sparingly branched; leaves setaceous from a lanceolate base, flexuose-spreading to more or less falcate-secund, often subtubulose above; costa broad, $1/2$ of the leaf base or more, excurrent into a rough point, prominent on the back, in cross section near the leaf middle showing a median row of guide cells between two stereid bands and a row of somewhat larger cells on both faces, often radiculose on the lower dorsal face; alar cells enlarged and often inflated and colored; cells of basal lamina nearly quadrate to elongated, broader near the costa and narrower at the margin. Dioicous; seta nearly erect when dry, more or less curved when moist; capsule erect and symmetric, oblong to cylindric, without stomata; annulus lacking in our species; peristome teeth separate to below the capsule mouth, divided $3/4$ the way down or more, and mostly longitudinally striate below and papillose above; calyptra not fimbriate or ciliate at base. Type species, *D. denudatum*.

Differs from *Campylopus* in the entire calyptra and the structure of the costa, from *Dicranum* in the deeper division of the peristome teeth.

KEY.

- Leaves nearly smooth to serrulate $1/3$ - $1/2$ the way down. 1. *denudatum*.
Leaves sharply serrulate to the broad leaf base. 2. *asperulum*.

I. DICRANODONTIUM DENUDATUM (Brid.) E. G. Britton, N. Am. Flora 15²: 151. 1913.

Dicranum denudatum Brid. Musc. Recent. Suppl. 1: 184. 1806.

Didymodon longirostris Starke, in Web. & Mohr. Bot. Tasch. 155. 1807.

Dicranodontium longirostre Bry. Eur. l. c. pl. 88. 1847.

Dicranodontium virginicum E. G. Britton, in Millsp. Bull. W. Va. Expt. Sta. 2: 488. 1892.

Dicranodontium Millsbaughii E. G. Britton, l. c.

♀ plants in compact tufts, soft, silky and pale green; stems 4-8 cm. high; stem leaves 5-7 mm. long, the slender awn 4-5 times as long as the broader base, somewhat flexuose; margin subentire or finely toothed toward the apex; costa $1/3$ - $1/2$ the width of the leaf at base, bistratose at insertion, above this as described for the genus; alar cells thin-walled, hyaline or colored, somewhat inflated and reaching to the costa; lower lamina cells oblong to rectangular, near the costa $12-16 \times 30-60 \mu$, somewhat pitted, narrower and thinner walled at the margin; inner perichaetial leaves the longest, convolute below. Seta about 1 cm. long, more or less curved; capsule oblong, smooth; peristome teeth cleft nearly or quite to their bases, or merely perforate below; operculum as long as the urn; spores $10-15 \mu$ in diameter; mature autumn to winter, infrequently produced. Type locality, Thuringia, Germany.

ILLUSTRATIONS:—Bry. Eur. *pl.* 88; Dixon, Handbk. Brit. Mosses (Ed. 3) *pl.* 13C; Braithw. Brit. Moss Fl. 1: *pl.* 17G; *Pl.* 43.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 71, (Ed. 2) 90; Holz. Musc. Acro. Bor. Am. 102.

On sandstone rocks and on peaty soil, usually in elevated regions in shaded places; New England to Alaska, south to Florida and Mexico.

2. *DICRANODONTIUM ASPERULUM* (Mitt.) Broth. Engler & Prantl (Ed. 1) Musci 1: 336. 1901.

Dicranum asperulum Mitt. Jour. Linn. Soc. 3: Suppl. 22. 1859.

Dicranodontium aristatum Schimp. Syn. 695. 1860.

Dicranum virginicum Aust. Bot. Gaz. 4: 150. 1879.

Campylopus virginicus Lesq. & James, Man. 80. 1884.

Plants slender, dark- to light-green, tufted, lustrous, silky; stems ascending to erect, 3–10 cm. high; leaves erect-spreading to secund even when dry, straight to variously curved and flexuose, up to 6 mm. long, linear-lanceolate, from a broader base, *serrulate nearly to the base*, with a very rough awn; alar cells inflated and usually hyaline; costa $\frac{1}{2}$ or more of the width of the leaf base, excurrent into a slender rough point; basal cells just above the alar, short-rectangular near the costa, about 15 μ wide, 1.5–3 : 1, narrower at the margin, much smaller higher up, often sublinear. Dioicous; male buds terminal, thick, borne on plants in separate tufts; seta 1.5–2 cm. long, sinuous and more or less arcuate when moist; capsule oblong, 1.5–2 mm. long; operculum rostrate, not quite the length of the urn; spores about 13 μ , mature in summer. Type locality, Sikkim. *Pl.* 44.

EXSICCATI:—R. & C. Musc. Am. Sept. 155.

On boulders and ledges in cool elevated regions; Pennsylvania and Virginia, south to Tennessee and Georgia; Williams reports from Alaska; also in Europe and Asia. Sporophyte rarely produced.

12. *CAMPYLOPUS* Brid. Musc. Recent. Suppl. 4: 71. 1819.

Plants in more or less compact sods, varying in size, often robust, resembling *Dicranum* in appearance but with leaves more rigid, less flexuose; stems branching, sometimes with flagellate branches in leaf axils, or branches clustered at the summit, radiculose; leaves mostly straight and erect-spreading when moist, in some cases more or less secund, usually narrowly lanceolate from a broader ovate to oblong, or ovate-lanceolate base, usually trough-like or subtubulose just above the broader base and channelled above this, usually dentate above; costa percurrent to long-excurrent, in most species more or less ribbed or lamellose at back, very broad below and in a few species excurrent into a hyaline hair-point; alar enlarged cells extending to the costa, much or little differentiated from those next above, often reddish or brown; leaf cells at the margin of the upper base usually narrower and often hyaline; the cells of the very narrow upper lamina mainly short and rectangular to rhomboidal, linear in a few species. Dioicous; seta mostly strongly arcuate when moist, sinuous-erect when dry; capsule symmetric or somewhat curved, smooth or sulcate when dry and empty, sometimes rough at base; annulus well developed; peristome teeth like those of *Dicranella*; operculum beaked; calyptra cucullate and *fimbriate at base* in most cases. Type species *C. flexuosus*.

As the greater number of our species rarely or never fruit, their determination is a matter of considerable difficulty and has led to a considerable difference of opinion in several cases.

The costa of *C. Schimperi* in cross section consists of a ventral row of large thin-walled cells, below this two or three irregular rows of smaller cells with rather thicker walls, with none of the small thick-walled stereid cells. The costa of the other species is essentially on the plan described for *C. introflexus* but with much less prominent ribs, usually but one cell high.

KEY.

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|--|------------------------|
| 1. Costa without stereid bands; plants of high altitudes and latitudes. | 8. <i>Schimperi</i> .* |
| Costa with stereid bands; plants mainly of the southern U. S. | 2. |
| 2. Leaves with a hyaline hair-point on most or all of the older leaves. | 8. |
| Leaves without hyaline hair-points. | 3. |
| 3. All or nearly all the cells of the broader leaf base more or less inflated and hyaline, alar cells not different. | 5. <i>fragilis</i> . |
| Only the cells of the lower $\frac{1}{2}$ or $\frac{1}{3}$ of the leaf base enlarged or inflated. | 4. |

* See p. 134.

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|---|--------------------------------|
| 4. Leaf cells of the upper lamina linear-flexuose, incrassate, with walls somewhat pitted..... | 1. <i>angustiretis</i> . |
| Leaf cells of upper lamina short-rectangular to oblong or rhomboidal..... | 5. |
| 5. Leaves as a rule dentate at apex only..... | 6. |
| Leaves toothed $\frac{1}{3}$ - $\frac{1}{2}$ the way down the slender awn..... | 7. |
| 6. Inflated alar cells present in all fully developed leaves and separated from the small quadrate cells by a considerable number of elongated rectangular cells..... | 4. <i>flexuosus</i> . |
| Inflated alar cells not always present; small quadrate and shortly rectangular cells extending almost to these when present..... | 3. <i>tallulensis</i> . |
| 7. Enlarged cells extending about $\frac{1}{3}$ the way up the broader leaf base, rather abruptly changing to small quadrate or short-rectangular cells..... | 3a. var. <i>subleucogaster</i> |
| Enlarged leaf cells extending up $\frac{1}{2}$ - $\frac{2}{3}$ the leaf base, rather gradually changing to the quadrate or rectangular to rhomboidal smaller cells..... | 2. <i>gracilicaulis</i> . |
| 8. Alar cells strongly differentiated, upper lamina cells narrowly oblong to linear. Alar cells scarcely differentiated, upper lamina cells short-oblong to obliquely rhomboidal..... | 7. <i>atrovirens</i> . |
| | 6. <i>introflexus</i> . |

1. CAMPYLOPUS ANGUSTIRETIS (Aust.) Lesq. & James, Manual 80. 1884.

Dicranum angustirete Aust. Bot. Gaz. 4: 150. 1879.

Plants in rather loose tawny tufts; stems mostly simple, 1-3 cm. high, not radiculose except at and near base; leaves rather loosely imbricate when dry, straight and equally spreading, often somewhat clustered above, the upper longer, reaching 5 mm. or more in length, long-lanceolate, concave, channelled above; costa about $\frac{1}{2}$ - $\frac{1}{3}$ the width of the leaf base, in cross section like that of *C. gracilicaulis*, excurrent into a toothed awn; alar cells conspicuously and abruptly inflated, reddish in the older leaves; cells next above these near the costa short-rectangular, 15-20 μ wide; median cells of lamina linear-flexuose with somewhat porose incrassate walls, all the marginal cells above the auricles very narrowly long-linear. Type locality, Jacksonville, Florida. Pl. 49.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 403, from "moist shaded sandy banks," Upsala, near Sanford, Florida (Rapp).

Distinguished from the common *C. gracilicaulis* by the narrower leaves less serrate above, more abruptly inflated and reddish colored alar cells and linear upper cells. Fruit unknown.

2. CAMPYLOPUS GRACILICAULIS Mitt. Jour. Linn. Soc. 12: 83. 1869.

Plants loosely gregarious or tufted; stems slender, up to 3 cm. high; lower stem leaves loosely appressed rather distant, the upper leaves and those of the very short subterminal branches forming a large compact terminal tuft, comal up to 6 mm. long, all narrowly lanceolate from a broader subclasping base, channelled above, serrulate about $\frac{1}{3}$ the way down; costa shortly to longly excurrent, often extending into a long green strongly toothed arista, about $\frac{1}{3}$ the width of the leaf at base, in the upper portion with low (1-2 cells) more or less toothed ribs, in cross section of a row of large clear ventral cells, below this a median row of slightly smaller chlorophyllose cells and at the back a layer of more or less interrupted stereid cells; alar cells more or less distinctly differentiated and inflated, above these a group of large short-rectangular cells extending up beside the costa and growing progressively narrower toward the margin, irregularly rectangular to rhomboidal or oblong, 1-2 : 1, smaller upwards; inner perichaetial leaves with a large ovate-oblong sheathing base in which the cells are larger and more lax than in the stem leaves, these large lax cells often nearly filling the entire base; costa $\frac{1}{6}$ - $\frac{1}{4}$ the width of the base. "Capsule (immature) oval, unequal, rough at the base, hidden among the comal leaves on a reflexed seta about 9 mm. long; calyptra fimbriate at base." Type locality "Igarape da Cachoeira," Brazil (Spruce No. 60). Pl. 49.

EXSICCATI:—Holz. Musc. Acro. Bor. Am. 355 (as *C. introflexus*), and 399.

Sandy fields and woods, Alabama, and common in southern Florida, where it has never been found in fruit, though archegonia are occasionally produced. Sometimes the plants have two stories, the upper apparently produced as an innovation from the lower comal tuft.

The type has been seen. The stem leaves are very strongly serrate above with the costa toothed on the back after the manner of *Dicranum scoparium*, and only shortly excurrent. The perichaetial leaves are

abruptly narrowed to a filiform rough awn with the costa long-excurrent. In most of the Florida plants that I have referred to this species the costa is less roughened and more longly excurrent. Some, however, match the Brazilian plant very closely in gametophyte characters. The alar cells in the type are only slightly or not at all differentiated. In the Florida plants they are much more differentiated. The calyptra is copiously fringed with long cilia; operculum about 0.7 mm. long. The leaf variation in the plants referred to this species is no greater than in our common *Dicranum scoparium*.

Plants in the U. S. National herbarium as *C. subleucogaster*, from Costa Rica, which I cannot differentiate from the common run of *C. gracilicaulis* from Florida, have perfect fruit matured in spring. When dry the seta is suberect and flexuose, but when moistened it becomes recurved bringing the capsule down to the leaves, it is 1 cm. or more in length. Capsule evenly striate when dry, symmetric, oblong, with a rough tapering neck; neck and urn 1.2-1.6 mm. long; operculum long-rostrate from a conic base, more than 1 mm. long; peristome teeth split nearly $\frac{1}{2}$ the way down, reddish and longitudinally striate at base and on base of forks, which are spinose-papillose and hyaline above; calyptra ciliate at base; spores about 15 μ , finely papillose.

Gracilicaulis, *Donnellii*, *fragilis*, *tallulensis*, *subleucogaster*, and *flexuosus* all have a costa section similar to that of *introflexus* except that the ribs are mostly but one cell high.

2a. Var. DONNELLII (Aust.) n. comb.

Dicranum Donnellii Aust. Bot. Gaz. 4: 150. 1879.

Campylopus Donnellii Lesq. & James, Man. 79. 1884.

Upper leaf cells longer and narrower, obliquely angled, 3-5 : 1.

EXSICCATI:—Aust. Musc. Appal. 470; Holz. Musc. Acro. Bor. Am. 402, 207.

Austin's original description cites his no. 470 and states that it occurred with *C. gracilicaulis*. A parallel column comparison of Williams' description of *gracilicaulis* and *Donnellii* shows little difference except the size and shape of the upper cells of the leaves. On sandy soil in Florida; frequent.

3. CAMPYLOPUS TALLULENSIS Sull. & Lesq. in Sull. Icones. Musc. 27. pl. 17. 1872.

Plants dark- to yellowish-green, brown and radiculose below; stems more or less branched, up to 4 cm. high; leaves erect-open when moist, loosely and evenly imbricated when dry or sometimes somewhat contorted, lanceolate from a broader base, up to 6 mm. long, subtubulose in the middle and channelled nearly or quite to the apex, finely toothed above; costa percurrent to shortly excurrent, ribbed and roughened to dentate on the back above (rarely to $\frac{1}{2}$ the way down as in Holzinger's 481), $\frac{1}{2}$ - $\frac{2}{3}$ the width of the leaf at base, in cross section much like that of *gracilicaulis* or *fragilis*; alar cells usually inflated, hyaline or colored; just above these a few larger short-rectangular hyaline cells near the costa, becoming narrower towards the margin; upper cells of this broader basal portion of the leaf quadrate to short-rectangular, 7-10 x 7-14 μ , some occasionally broader than long, some rhomboidal, as are most of those in the narrow upper lamina. Type locality, Tallulah Falls, Georgia.

ILLUSTRATIONS:—Sull. Icones Musc. pl. 17; Pl. 50.

EXSICCATI:—Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 73b, (Ed. 2) 93; Small, Mosses southern U. S. 41; Holz. Musc. Acro. Bor. Am. 481 (not typical); Bartram, Mosses of Southern Arizona 103, as *C. subleucogaster*.

On soil and ledges that are moist during certain seasons; Tennessee, Georgia, Alabama, Arizona, Florida; not known in fruit.

The alar cells are often little inflated. Further the leaves on the same plant vary considerably in the areolation of the base. This does not include young leaves as the alar cells do not reach their full development until the leaves are fully mature. Dixon (Handb. Brit. Mosses 95) says that the inflated alar cells of *C. flexuosus* are "occasionally almost obsolete." Mexican and Central American plants have been referred to *C. flexuosus* by competent European authorities. To the author it seems that *flexuosus*, *tallulensis* and *subleucogaster* belong to the same specific type. Certainly the differences are no greater than are found in plants generally referred to *Dicranum scoparium*. Macoun's Vancouver Island plant which Williams cites as *flexuosus* should be referred to *tallulensis* according to the leaf structure of the plants I have seen, if *tallulensis* is to stand. As a final decision, it is a synonym of *C. flexuosus*.

3a. Var. SUBLEUCOGASTER (C. Muell.) n. comb.

Dicranum subleucogaster C. Muell. in C. Mohr, Bull. Torr. Club. 5: 49. 1879.

Dicranum zygodonticarpum C. Muell. Linnaea 42: 471. 1878.

Campylocarpus subleucogaster Jaeger & Sauerb. Ber. St. Gall. Nat. Ges. 1877-78: 381. 1879.

Leaf apex long and slender, strongly toothed, usually a greater area of large cells above the inflated alar cells. Type from Alabama, seen and studied. Pl. 49.

The above are the only material differences between the types of *Dicranum subleucogaster* and *Campylopus tallulensis* [Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 73b]. Besides the type collection it has been collected once or twice in Florida and reported from various other localities.

4. *CAMPYLOPUS FLEXUOSUS* [L.] Brid. Musc. Recent. Suppl. 4: 71. 1819.

Plants in compact sods, green above, brown and radiculose below; extremely variable in size and habit, 1-6 cm. high, often bearing flagellate clustered branches; leaves straight, small and rigid or long and flexuose when dry, sometimes secund above, lanceolate-subulate from an oblong base, tubular to channelled above, denticulate at the apex and occasionally farther down; costa, $\frac{1}{2}$ - $\frac{1}{3}$ the width of the base; costa and leaf cells much as in the last except that there are more elongated-rectangular cells between inflated alar cells and small quadrate cells. Seta 8-10 mm. long, curved; capsule about 2 mm. long, ovoid becoming oblong-cylindric when empty, furrowed, often somewhat unsymmetric; exothelial cells narrow, incrassate; annulus broad; peristome normal; operculum obliquely rostrate, $\frac{1}{2}$ - $\frac{2}{3}$ the length of the urn; calyptra fimbriate; spores finely papillose, 14-16 μ in diameter; mature late winter to spring. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. pl. 89; Braithw. l. c. pl. 18F; Dixon, Handb. Brit. Mosses (Ed. 3) pl. 12B; Pl. 48.

On moist shaded soil and rocks; Ohio, also in Mexico and Central America.

A careful comparison failed to show any important differences between this and *C. tallulensis* except that the short-rectangular and quadrate cells come closer to the inflated alar cells in *tallulensis* than in *flexuosus*. Small's Mosses of the Southern U. S. no. 41 seems to be *C. flexuosus*.

5. *CAMPYLOPUS FRAGILIS* [Dicks.] Bry. Eur. fasc. 41. pl. 90. 1847.

Bryum fragile Dicks. Pl. Crypt. Brit. 3: 5. 1793.

Dicranum flexuosum var. *fragile* Turn. Musc. Hib. 74. 1804.

Dicranum densum Schleich. Exs. & Cat. 1807. (*C. densum* Bry. Eur. pl. 93.)

Campylopus pencillatus Brid. Musc. Recent. Suppl. 4: 73. 1819.

Plants in compact tufts, up to 4 cm. high, usually shorter, more or less whitish below because of the pale bases of the leaves, which are up to 5 mm. long, densely imbricate, uniformly erect-spreading when moist, narrowly lanceolate from a broader concave base, serrulate in the upper $\frac{1}{3}$, much like those of *C. introflexus* in costa and areolation, except as follows; nearly the whole broad basal portion of the lamina is made up of large, somewhat inflated cells, little different from the alar; the costa is shortly excurrent, with less prominent dorsal ribs and is bordered above by a very narrow band of short cells.

The capsule is bent down in the leaves by the curving of the 5-8 mm. seta; capsule pyriform-elliptic, symmetric, plicate when dry and empty; operculum rostrate, about $\frac{1}{2}$ the length of the urn; annulus narrow; peristome normal; spores 14-16 μ . Type locality, Great Britain.

ILLUSTRATIONS:—Bry. Eur. l. c.; Braithw. Brit. Moss Fl. 1: pl. 18A; Limpr. Laubm. 1: 394. f. 130; Dixon, Handbk. Brit. Mosses (Ed. 3) pl. 12B; Pl. 48.

On soil in Florida, sterile only; rare.

6. *CAMPYLOPUS INTROFLEXUS* (Hedw.) Brid. Bryol. Univ. 1: 472. 1826.*

Dicranum introflexum Hedw. Sp. Musc. 147. 1801.

Campylopus polytrichoides DeNot. Syll. Musc. 222. 1838.

Campylopus leucotrichus Sull. & Lesq., Sull. Icones. Musc. 28. pl. 17. 1864.

Campylopus longipilus Brid. Bryol. Univ. 1: 477. 1826, in part.

Plants dark to golden green above, brown to blackish below, in rather close sods; stems 0.5-3 cm. or more high (reaching 7 cm. according to Limpricht), more or less branching, radiculose below; leaves loosely appressed-imbricate when dry, reaching 6 mm. in length, erect-open when moist, mostly lanceolate-subulate, straight, rigid, concave, channelled to subtubulose above, mostly ending in a rough hyaline awn of varying length, consisting of the excurrent costa, the upper tufted and longer, 2-5 mm. long; costa $\frac{2}{3}$ - $\frac{3}{4}$ the width of the leaf base, with more or less serrulate ribs or lamellae 2-6 cells high on the back of the upper half, in cross section a little above the middle showing a ventral row of large clear, incrassate cells with

* For a full synonymy of this much named species see The N. Am. Flora 15²: 144.

lumen about $7\ \mu$, below these a row of similar chlorophyllose cells, and at the back stereid cells with interspersed large cells and then the large projecting cells of the ribs; alar cells little inflated, hyaline or colored, forming indistinct auricles; the cells next above these rectangular to sublinear, hyaline and running up the margin as in *Tortella*, rather abruptly passing into the small, very thick-walled cells of the middle lamina, which are quadrate or obliquely rhomboidal, obliquely arranged and much narrower at the margin, having a lumen $12-18 \times 7-12\ \mu$ in some plants; "inner perichaetial leaves with a convolute blade extending nearly to the base of the hyaline rough point." Dioicous; seta 6-9 mm. long, rough near the capsule, flexuous; capsules often aggregated, short-oblong to ovoid, nearly symmetric, rugose at base and somewhat furrowed when dry and empty; operculum obliquely short-rostrate; perisome red-brown, the teeth split about $\frac{1}{2}$ the way down; calyptra ciliate at base; spores rough, up to $13\ \mu$. Type locality, New Zealand.

ILLUSTRATIONS:—Sull. l. c.; Hedw. l. c. *pl.* 29, *f.* 1-7; Braithw. Brit. Moss Fl. 1: *pl.* 19C; Bry. Eur. *pl.* 93; Limpr. Laubm. 1: 400, *f.* 133; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 13a; *Pl.* 43.

EXSICCATI:—Bartram, Mosses Southern Arizona 54, 50 (a depauperate form without hyaline apex).

Tennessee, Georgia, Arizona, Mexico, W. Indies and southwards. Although apparently a moss of low latitudes, in N. America seems to be found on open cliffs and banks at a considerable altitude. Sharp's specimens from Tennessee have all the upper leaves with a long hyaline hair point, dorsal lamellae reaching 6 cells high and short oval or oblong cells. The description of the sporophyte is taken bodily from William's description in N. Am. Flora l. c. Small's Georgia Mosses 442 from the Canyon at Tallulah Falls, alt. 1400-1800 ft., April 1893, is undoubtedly *C. introflexus* although none of the leaves have hyaline points. His 139 from Little Stone Mt., April 1893 is the same thing with the lamellae a little higher and some of the leaves with short hyaline points. Also in Jackson Co., Ohio, a similar form was collected by A. J. Sharp.

Bartram's Mosses of S. Arizona no. 58, as *C. subleucogaster*, is also an epilose form of *C. introflexus*. These epilose forms may be distinguished from *C. tallulensis* by the less developed alar cells, wider costa and larger area of hyaline basal cells extending half way up the broad part of the leaf base. In *C. fragilis* this area of enlarged hyaline basal cells fills almost all the wider leaf base. Probably the epilose forms are merely juvenile or depauperate.

7. *CAMPYLOPUS ATROVIRENS* DeNot. Syll. Musc. 221. 1838. (Not of Bry. Eur. according to Limpricht, Laubm. 1: 398, but cited as a synonym by Braithwaite, Brit. Moss Fl. 1: 135.)

Campylopus longipilus Brid. Bryol. Univ. 1: 477. 1826 (in part only).

Differs from *C. introflexus*, which it closely resembles, in the following characters:—the alar cells are strongly differentiated and inflated, the upper cells of the lamina narrowly oblong to linear and flexuose, often pitted; ribs on the costa mostly only one cell high. Bare cliffs, Chestnut Bald Mt., N. Carolina, alt. 5900 ft. Aug. 4. 1907 (Grout).

Identified and distributed as *C. introflexus* at the time, but careful comparison with European material makes it certain that it is this species.

ILLUSTRATIONS:—Bry. Eur. Suppl. fasc. 1-2, *pl.* 3; Braithw. Brit. Moss Fl. 1: *pl.* 19B; Dixon, Handbk Brit. Mosses (Ed. 3) *pl.* 12G; *Pl.* 48.

13. *BROTHERA* C. Muell. Gen. Musc. 258. 1901.

A monotypic genus differing from *Campylopus* in having the cross section of costa showing a dorsal and a ventral layer of large cells and no stereid bands, alar cells not differentiated; seta erect but slightly sinuous, capsule erect.

BROTHERA LEANA (Sull.) C. Muell. l. c. 259.

Leucophanes ? *Leanum* Sull. Musc. Allegh. 172. 1845.

Campylopus Leanus Sull. in A. Gray, Man. (Ed. 2) 619. 1856.

Leucobryum Leanum Kindb. Eur. & N. Am. Bryin. 176. 1897.

Brothera Ankerkronae C. Muell. Gen. Musc. 258. 1901.

Plants more or less densely cespitose, less than 1 cm. high, straw-color, darker below; stems radiculose throughout, branching by slender capitate fasciculate innovations, uniformly foliate; leaves crowded, erect-spreading, lanceolate-subulate, 2-3 mm. long (Williams says 3-3.5), channelled and entire above or with a few minute teeth at apex; costa broad and flat, filling most of the upper part of the leaf and $\frac{1}{2}$ or more of the base, in cross section in the lower part of the leaf with a more or less disconnected row of somewhat smaller cells between the dorsal and ventral layers; cells of the lamina, pale, thin-walled, linear-oblong,

narrower at the margin, only a little larger at the base as a rule, occasionally some of the basal cells somewhat inflated; perichaetial leaves similar to the upper stem leaves; often in the axils of the upper leaves numerous narrow deciduous aborted or rudimentary leaflets, 0.5-1 mm. long. Dioicous, "seta up to 7 mm. long, smooth, erect, somewhat sinuous and twisted; capsule oblong to elliptic, 1-1.3 mm. long, without stomata, smooth above, slightly rugose at the base;" "annulus large, of two rows of cells; peristome teeth inserted below the mouth, divided to near the base into two subulate, indistinctly articulate, densely papillose forks; lid with a long erect beak; calyptra large, cucullate, ciliate at base; spores nearly smooth, 10-12 μ in diameter." (Description of fruit copied from N. Am. Flora 15²: 134, which Williams drew mostly from a Japanese specimen, as N. Am. plants are sterile.) Type locality, Ohio.

ILLUSTRATIONS:—Sull. Icones Musc. *pl.* 18; *Pl.* 50.

EXSICCATI:—Sull. l. c., (Ed. 2) 94; Holz. Musc. Acro. Bor. Am. 9; Grout, Musci Perf. 272.

On bark of trees, rotten logs or humus in shaded localities; Pennsylvania, Ohio, Tennessee and Minnesota; also Siberia, the Himalaya region and Japan.

14. PARALEUCOBRYUM (Lindb.) Loeske, Hedwigia 47: 171. 1908. Lindb. Musc.

Scand. 23. 1879, as section of *Dicranum*.

Plants with a *Dicranum* habit, of medium size; costa very broad, not semiterete, filling all or nearly all the leaf above the middle, without guide cells, composed of 3-4 layers of cells of nearly uniform size and thickness of wall, the middle layer and often the lower layer also more or less chlorophyllose. Dioicous; capsules cylindric, erect and symmetric, or nearly so. Otherwise as in *Dicranum*. Type species *P. longifolium*? Evidently this genus is a connecting link between *Dicranum* and *Leucobryum*.

KEY.

- | | |
|---|-------------------------|
| Costa 9/10 or more of the width of the leaf at base..... | 3. <i>enerve</i> . |
| Costa often more than $\frac{1}{2}$ the width of leaf base..... | 1. <i>longifolium</i> . |
| Costa usually less than $\frac{1}{2}$ the width of the leaf base..... | 2. <i>Sauteri</i> . |

1. PARALEUCOBRYUM LONGIFOLIUM (Hedw.) Loeske, l. c.

Dicranum longifolium Hedw. Stirp. Crypt. 3: 24. *pl.* 3. 1791; Sp. Musc. 130. 1801.

Dicranum serratum Kindb. Eur. & N. Am. Bryin. 190. 1897.

Campylopus canadensis Kindb. Rev. Bryol. 32: 35. 1905.

Dicranum albicans var. *denticulatum* Kindb.; Macoun, Cat. Can. Pl. 6: 261. 1892.

Plants in rather dense silky tufts, light- to dark-green; stems slender, 3-4 cm. long, occasionally more; leaves little changed in drying, mostly falcate-secund, 4-7 mm. long, narrowly long-lanceolate, subulate-tubulose above and very rough; costa more than $\frac{1}{2}$ the width of the leaf base, occupying all the upper part of the leaf, in cross section as described for the genus, ribbed on the back; inflated alar cells reaching the costa; cells of the narrow lamina hexagono-rectangular, 4-6:1, with the walls somewhat pitted, smaller upwards; perichaetial leaves abruptly subulate from a broad clasping base having a much broader lamina. Seta 1-2 cm. long; capsule nearly erect and symmetric, oblong-cylindric, somewhat wrinkled when dry and empty, 2-2.5 mm. long; operculum long-rostrate, scarcely as long; annulus lacking; peristome teeth split more than $\frac{1}{2}$ down, obliquely striate below; spores 18-24 μ , maturing in summer. Type locality, European.

ILLUSTRATIONS:—Hedw. l. c.; Bry. Eur. *pl.* 72; M. H. M. *pl.* 17; Braithw. Brit. Moss Fl. 1: *pl.* 24B; Dixon, Handb. Brit. Mosses (Ed. 3) *pl.* 15H; *Pl.* 44.

EXSICCATI:—Drumm. Musc. Am. 94; Sull. Musc. Allegh. 161; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 58, (Ed. 2) 74; Aust. Musc. Appal. 84; R. & C. Musc. Am. Sept. 294; Holz. Musc. Acro. Bor. Am. 132; Grout, Musci Perf. 158, 181.

On rocks, more rarely on bases of trees in alpine or subarctic regions; Newfoundland to Alaska; south to North Carolina and Colorado.

1a. Var. SUBALPINUM Milde, Bryol. Siles. 68. 1869.

A reduced alpine form with leaves blackish, nearly straight and equally spreading, shorter and less roughened above. Probably in suitable habitats throughout the northern range of the species. Holz. Musc. Acro. Bor. Am. 294.

2. *PARALEUCOBRYUM SAUTERI* (Schimp.) Loeske, l. c.*Dicranum Sauteri* Bry. Eur. fasc. 37-40. *pl.* 71. 1847.*Campylopus frigidus* Lesq.; Porter & Coult. Syn. Fl. Colo. 155. 1874, in part.

Subspecies of *P. longifolium*; distinguished by the shorter leaves, smoother above, much broader leaf lamina and costa usually less than $\frac{1}{3}$ the width of the leaf base; peristome teeth smoother, little or not at all striate. Type locality, Austria.

ILLUSTRATIONS:—Bry. Eur. l. c; *Pl.* 51.

Mountains of British Columbia, Colorado and Arizona.

3. *PARALEUCOBRYUM ENERVE* (Thed.) Loeske, l. c.*Dicranum enerve* Thed.; Hartm. Skand. Fl. (Ed. 5) 393. 1849.*Dicranum albicans* Bry. Eur. fasc. 43. *Dicranum* Suppl. *pl.* 73. 1850.*Campylopus Hallii* Lesq.; Porter & Coult. l. c. 155.

Plants in compact tufts, light-green; stem leaves in robust European plants sometimes falcate secund; American plants are mostly slender and differ from *P. longifolium* in having leaves erect-spreading, nearly straight, with only a thin line of lamina above the alar cells; usually entire and smooth above, sometimes with a few teeth at apex; operculum as long as urn. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. l. c; *Pl.* 51.

EXSICCATI:—Macoun, Can. Musci 56, 404.

On rocks; arctic-alpine; Alaska, British Columbia, Colorado and New Mexico; rare in N. America.

KEY TO GENERA.

- | | |
|--|---------------------------|
| 1. Alar cells not conspicuously enlarged or inflated | 2. |
| Alar cells conspicuously enlarged or inflated or both (<i>Blindia</i> may be sought here) | 13. |
| 2. Leaf cells smooth or nearly so | 3. |
| Leaf cells strongly papillose or mamilllose | 10. |
| 3. Leaves not crisped when dry | 4. |
| Leaves crisped when dry (except forms of <i>♂</i>) | 6. |
| 4. Stems julaceous; stem leaves erect-appressed, ovate to ovate-lanceolate, obtuse | 2. <i>Angstroemia</i> . |
| Stems not julaceous; leaves not appressed, narrowly lanceolate from a broader base | 5. |
| 5. Costa at least $\frac{3}{4}$ the width of the leaf base | 13. <i>Brothera</i> . |
| Costa less than $\frac{1}{2}$ the width of the leaf base | 1. <i>Dicranella</i> . |
| 6. Capsule deeply ribbed when dry | 7. |
| Capsule smooth or slightly striate when dry | 9. |
| 7. Peristome teeth divided at least $\frac{1}{2}$ the way down (nos. 1, 2, 3) | 6. <i>Oncophorus</i> . |
| Peristome teeth not divided (except occasionally at extreme apex) | 8. |
| 8. Leaf margins serrulate (in our species); peristome teeth linear-lanceolate | 3. <i>Rhabdoweisia</i> . |
| Leaf margins entire except at extreme apex; peristome teeth lanceolate | 8. <i>Dicranoweisia</i> . |
| 9. Capsules strumose (Nos. 8, 9, 10) | 6. <i>Oncophorus</i> . |
| Capsules not strumose | 7. <i>Symblepharis</i> . |
| 10. Leaf margins bistratose (Nos. 1, 3, 7) | 6. <i>Oncophorus</i> . |
| Leaf margins unistratose | 11. |
| 11. Larger radicles often papillose; peristome teeth undivided | 4. <i>Oreoweisia</i> . |
| Radicles smooth; peristome teeth divided at least $\frac{1}{2}$ the way down | 12. |
| 12. Capsules ribbed when dry (Nos. 4, 5, 6) | 6. <i>Oncophorus</i> . |
| Capsules not ribbed when dry | 5. <i>Dichodontium</i> . |
| 13. Costa semiterete, less than $\frac{1}{2}$ the width of the leaf base | 14. |
| Costa flattened, at least $\frac{1}{3}$ the width of the leaf base | 16. |
| 14. Peristome teeth undivided, with vertical striae few or lacking | 8. <i>Dicranoweisia</i> . |

- Peristome teeth divided about $\frac{1}{2}$ the way down, vertically striate on the outer face in most species..... 15.
15. Costa of homogeneous cells..... 9. *Arctoa*.
Costa of heterogeneous cells..... 11. *Dicranum* and 6. *Oncophorus*. sp.
16. Costa without stereid bands..... 17.
Costa with well defined stereid bands above and below the guide cells... 19.
17. Large empty cells on both surfaces of the costa..... 13. *Brothera* & *Paraleucobryum*.
Large empty cells on the upper surface only of the costa..... 18.
18. Guide cells present; calyptra fimbriate; capsule without stomata..... 12. *Campylopus Schimperi*.
Guide cells lacking; calyptra not fimbriate; capsules with stomata..... 14. *Paraleucobryum*.
19. Upper surface cells of the costa larger than the guide cells; calyptra fimbriate..... 12. *Campylopus*.
Median guide cells the largest cells in cross section of costa; calyptra not fimbriate..... 11. *Dicranodontium*.

LEUCOBRYACEAE.

Plants with sporophyte structure much like that of the *Dicranaceae*. The whitish gametophyte differs in that the stem has no central strand and that the leaves consist mostly of a costa of three or more layers of two kinds of cells, the outer large, hyaline and porose on the inner walls, without chlorophyll (leucocysts). These inclose a row, rarely more, of small chlorophyll bearing cells (chlorocysts), which are angled and 3-4-sided.

KEY.

- Leaves plane above, widely spreading to recurved when dry; chlorocysts triangular in cross section; capsules erect and symmetric; peristome teeth 8..... 1. *Octoblepharum*.
Leaves subtubulose above, less widely spreading when dry; chlorocysts 4-sided in cross section; capsules unsymmetric, inclined, often strumose; peristome teeth 16, forked as in *Dicranum*..... 2. *Leucobryum*.

OCTOBLEPHARUM Hedw. Stirp. Crypt. 3: 15. pl. 6A. 1791; Sp. Musc. 50. 1801.

We have only the type species.

OCTOBLEPHARUM ALBIDUM (L.) Hedw. l. c.

Plants usually in small tufts, rather compact, whitish, rarely tinged with reddish; stems branching, 0.5-3 cm. long, branching; leaves scarcely changed in drying, widely spreading to recurved, up to 6 mm. or more in length, oblong-lingulate from a broader more hyaline and more erect base, narrowed to the insertion, rounded-apiculate and serrulate at apex, in median cross-section showing mostly 4 layers of cells above and 3 below the triangular chlorocysts; lamina at base, small and narrow; perichaetial leaves little differentiated. Autoicous, male flowers scattered along the stem; setae mostly solitary, erect and straight, 4-7 mm. long; capsule ovoid to short-oblong; erect and symmetric; operculum obliquely short-rostrate; annulus lacking; peristome teeth 8, triangular, smooth, lightly striate longitudinally, sometimes perforate along the median line; spores rough, up to 22 μ , mature in winter. Type locality, Bahamas.

ILLUSTRATIONS:—Hedw. l. c.; Pl. 52.

EXSICCATI:—Aust. Musc. Appal. 478; R. & C. Musc. Am. Sept. 213; Small, Mosses southern U. S. 52; Grout, Musci Perf. 46; Holz. Musc. Acro. Bor. Am. 57.

Principally on the bases of trees and trunks of palms; common in southern Florida. Also reported from Texas by Austin.

2. LEUCOBRYUM Hampe, Flora 20: 282. 1837.

Plants in dense whitish cushions, round and wide spreading in maximum development, brittle when dry; stems branching, up to 20 cm. long; leaves oblong-lanceolate, rather crowded, with an appressed-imbricate base and a more or less spreading subtubulose upper portion, which is sometimes secund (rarely so in our species) mostly denticulate at apex, all parts composed mostly of the highly developed costa with a very narrow lamina in the basal portion; costa in cross section consisting of a single row of small quadrate

sharply angled chlorocysts with from one to 4 rows of leucocysts on each side; lamina a hyaline border in the lower part of the leaf composed of 5-10 rows of narrow hyaline cells; radicles often appear at the apex of the leaves. Sporophyte dicranoid; capsule on a long-exserted seta, more or less inclined and unsymmetric, more or less striate when dry and empty; operculum long-rostrate; annulus and stomata mostly lacking; peristome teeth forked, more or less striate longitudinally and papillose on the prongs. Type species *L. glaucum*.

KEY.

1. Leaves up to 4.5 mm. long, upper tubulose portion not longer than the broad appressed portion, usually shorter. 2. *albidum*.
 Leaves up to 10 mm. long, upper tubulose portion longer than the basal portion, up to 3 times as long. 2.
2. Leaves erect-spreading at a small angle when dry, in cross section near the base showing in part 3-4 rows of leucocysts. 1. *glaucum*.
 Leaves spreading-flexuose at a much wider angle, in cross section near the base showing only a single row of leucocysts on each side of the chlorocysts. 3. *antillarum*.

1. LEUCOBRYUM GLAUCUM (Hedw.) Schimp. Coroll. Bry. Eur. 19. 1855.

Dicranum glaucum Hedw. Stirp. Crypt. (Fundamant?) 2: 92. 1782 and Sp. Musc. 136. 1801.

Leucobryum vulgare Hampe, l. c.

Mature plants in deep rounded cushions up to 10 cm. or more high, peaty below; leaves crowded, 3-10 mm. long, from an oblong or ovate base gradually narrowed to a subtubular narrower upper portion, minutely denticulate at the abruptly acute apex; costa in cross section near the base showing a single or usually a partially double row of leucocysts on the upper and lower side of the chlorocysts and in the thickest part of the leaf with 2-3 layers of leucocysts above and below the single chlorocyst layer; hyaline lamina on each side of the base about 5 cells wide. Psudautoicous; male plants 2-6 mm. high, growing on tufts of tomentum within the lower perichaetial leaves; capsule usually distinctly strumose, strongly curved and furrowed when dry, 1.5-2 mm. long, on a seta 1.5-2 cm. long; operculum about the length of the urn; spores 15-20 μ ; mature in autumn and persisting through the winter. Type locality, European.

ILLUSTRATIONS:—Bry. Eur. *pl.* 97, 98; Braithw. Brit. Moss Fl. 1: *pl.* 13; Dixon, Handbk. Brit. Mosses (Ed. 3) *pl.* 16B; Limpr. Laubm. 1: 420. *f.* 141; M. H. M. *f.* 49; Mosses w. Hand-lens *pl.* 24; *Pl.* 52.

EXSICCATI:—Drumm. Musc. Am. 89; Sull. Musc. Allegh. 168; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 76, (Ed. 2) 97, 98 in part; Aust. Musc. Appal. 99; Macoun, Can. Musci 55; Holz. Musc. Acro. Bor. Am. 82, 618; Grout, Musci Perf. 44; R. & C. Musc. Am. Sept. 277, as *L. albidum*.

On soil and rocks in shaded places, very common but fruiting infrequently; Newfoundland to Minnesota; south to Florida and Louisiana. Although the species thrives in places that are rather dry most of the time, it seems to fruit more freely when more abundant moisture is present.

2. LEUCOBRYUM ALBIDUM (Brid.) Lindb. Oefv. Sv. Vet.-Akad. Förh. 20: 403. 1863.

Dicranum albidum Brid. Musc. Recent. 2: 167. 1798 and Sp. Musc. 205. 1806.

Dicranum glaucum pumilum Mx. Fl. Bor. Am. 2: 297. 1803.

Leucobryum vulgare minus Hampe, Linnaea 13: 42. 1839.

Leucobryum sediforme C. Muell. Syn. 1: 75. 1848.

Leucobryum minus Hampe; Sull. in A. Gray, Man. (Ed. 2) 624. 1856.

Leucobryum pumilum E. G. Britton, Bull. Torr. Club. 19: 190. 1892.

Leucobryum incurvifolium C. Muell. Bull. Herb. Boiss. 5: 174. 1897.

Smaller than the last, up to about 3 cm. high, with the leafy stems much more slender; leaves smaller, 2-4.5 mm. long, with the narrowed subtubulose point rarely as long as the broad base and often much shorter; capsules more frequently not strumose, averaging smaller. Type locality, Virginia. *Pl.* 52.

EXSICCATI:—Drumm. Musc. Am. 40, 45; Sull. Musc. Allegh. 169; Sull. & Lesq. Musc. Bor. Am. (Ed. 1) 77, (Ed. 2) 98 in part; Aust. Musc. Appal. Suppl. 477; Small, Mosses southern U. S. 17; R. & C. Musc. Am. 18; Holz. Musc. Acro. Bor. Am. 56; Grout, Musci Perf. 45.

On soil, fallen logs and bases of trees; Connecticut (Det. Williams) to New Jersey and Ohio; south to Florida and Texas. Common in Florida.

The southern plants are very distinct but become less so towards their northern limit. Immature or depauperate specimens are hard to place.

3. LEUCOBRYUM ANTILLARUM Schimp.; Besch. Ann. Sci. Nat. VI. 3: 190. 1876.

Leucobryum costaricense Besc. Journ. de Bot. 11: 153. 1897.*Leucobryum Jamaicense* C. Muell. Bull. Herb. Boiss. 5: 547. 1897.*Leucobryum subglaucum* C. Muell. l. c. 548.*Leucobryum sciuroides* C. Muell. Hedwigia 37: 221. 1898.*Leucobryum Eggersianum* C. Muell. Hedwigia l. c.*Leucobryum glaucovirens* Card. Rev. Bryol. 36: 69. 1900.*Leucobryum flaccidulum* Card. Rev. Bryol. 37: 119. 1910.(This synonymy is after Williams, N. Am. Flora 15²: 165.)

Plants in rather loose tufts, differing from *L. glaucum* in the more widely spreading and flexuous leaves, showing in cross section near the base but a single layer of leucocysts each side of the row of chlorocysts, marginal lamina up to 8 cells wide. Capsules smaller and less curved. Type locality, Guadeloupe. Pl. 52.

Throughout the West Indies and from Mexico to northern S. America. Collected near Sebring, Florida, by J. B. McFarlin. Plants occur that can be told from *D. glaucum* by careful dissection only.

Family POLYTRICHACEAE*

Plants largely stiff and coarse, most species becoming reddish or brownish at least with age, mostly forming loose to dense sods; stems erect, at least usually from a creeping branched rhizome, commonly with the basal portion bearing reduced and usually very small bracts, with central strand of two kinds of cells; leaves mostly with sheath, in nearly all with longitudinal lamellae on the upper side, often crispate when dry; costa one, narrow, or indefinitely wide; cells of the upper half of the limb isodiametric to somewhat wider than long or somewhat longer than wide. Calyptra often quite hairy; seta long; capsule well exerted; teeth 0, 32 or approaching 64 through doubling, in 1 row, composed of whole thickened cells, unbarred.

KEY

- A. Leaf limb between the lamellae and the margin 1 cell thick except the elongate border cells when present; capsule with peristome.
- B. Lamellae on upper side of leaf 1-15, sometimes none on most of the leaves of *Atrichum crispum*; about the middle of the limb the unistratose region more than 8 cells wide; capsule not longitudinally ridged, without hypophysis; calyptra smooth or nearly so; marginal cells of the lamellae like the others, not thicker walled.
- C. Leaves bordered with long narrow cells; capsules without stomata. 1. *Atrichum*.
- CC. Leaves not bordered with long narrow cells; capsules with stomata. 2. *Oligotrichum*.
- BB. Lamellae 25-70 (except in *Pogonatum pensilvanicum* only 10-15); about the middle of the limb the unistratose portion 1-8 cells wide; capsule longitudinally ridged in most species, with distinct hypophysis in most species; calyptra long-hairy, densely so except in *Polytrichadelphus Lyallii*.
- D. Capsule terete; calyptra densely long-hairy; capsule with or without stomata; teeth of peristome 32 or these more or less completely doubled. 5. *Pogonatum*.
- DD. Capsule 4-6-angled; capsule with stomata; teeth of peristome 64.
- E. Capsule longitudinally 4-ridged, the two upper ridges closer together; calyptra sparingly hairy and thus its body quite easily seen. 4. *Polytrichadelphus*.
- EE. Capsule longitudinally 4-6-ridged, the ridges equally spaced; calyptra densely long-hairy and thus its body hidden. 6. *Polytrichum*.
- AA. Leaf limb between lamellae and margin 2 cells thick throughout most of its area; capsule without peristome; calyptra smooth; marginal cells of the lamellae like the others at least in thickening; plants known only from Greenland, Alaska and British Columbia. 3. *Lyellia*.

* By Dr. Theodore C. Frye of the University of Washington. Dr. Frye's citations are often a little different in form from those used in other parts of the book, but they are usually a little more complete and will be easily correlated.

The following have materially assisted in the preparation of this work: Mrs. Elizabeth Young in arrangement, reading of typed matter and making of drawings; in the making of drawings Elizabeth Curtis, Sylvia Edmonds and Harriet Rudolf. Drawings made by the above are initialed.

SYNOPSIS OF THE GENERA

Hairs of the calyptra wanting or too few to hide its body.

Peristome with teeth; lamina 1 cell thick except sometimes the border.

Capsule without longitudinal ridges; lamellae few, rarely none.

Leaves bordered with long narrow cells; capsules without stomata . . . *Atrichum*.

Leaves not bordered with long narrow cells; capsules with stomata . . . *Oligotrichum*.

Capsule with 4 (or 2) longitudinal ridges; lamellae numerous . . . *Polytrichadelphus*.

Peristome wanting; lamina 2 cells thick in most of its area . . . *Lyellia*.

Hairs of the calyptra completely hiding its body.

Capsule terete . . . *Pogonatum*.

Capsule longitudinally ridged . . . *Polytrichum*.

1. ATRICHUM Beauv. Prodr. 42. 1805.

Catharinea Ehrh., Han. Mag. 1780: 933. 1780; also Beitr. 1: 178. 1787.

Plants rather vigorous, green or later brownish or reddish, forming thin sods or patches; erect stems from subterranean twisted and much branched rhizomes, simple, with central strand, densely rhizoidous at base; leaves flat to involute-tubular, without sheath, often transversely undulate, ligulate to linear-lanceolate, bordered with elongate cells, mostly crispate when dry; margin singly or doubly serrate; lamina often with teeth on the back; costa vanishing or percurrent, toothed on the back above, with a few lamellae on the upper side; even the marginal cells of the lamellae smooth; leaf cells quite green, smooth (except 4 & 5), the upper roundish-hexagonal, the lower mostly rectangular. Dioicous or monoicous; calyptra narrow, cucullate, smooth or with the tip from slightly papillose to slightly hairy; setae 1-6 from a stem tip; capsule somewhat inclined, smooth, commonly longly cylindrical, often slightly curved, terete, without hypophysis constricted from the urn; stomata none; teeth 32; lid convex, beaked.

Atrichum is a *nomen conservandum*. Ehrhart's spelling of *Catharinea* was corrected by O. Sendtner in Habilitationsschrift 14, 1848, to *Catharinaea*, the feminine form. Since that time some authors have followed one spelling and some the other.

KEY

A. Leaf cells smooth.

B. Leaves ovate to elliptical or obovate.

C. Teeth abortive or wanting on back of costa near tip; lamellae 0-3 cells high; cells of leaf at 3/4 up markedly smaller toward margin 1. *crispum*.

CC. Teeth present on back of costa near tip; lamellae 4-8 cells high; cells of leaf at 3/4 up slightly smaller toward margin 1a. *Var. molle*.

BB. Leaves lingulate to somewhat lanceolate.

D. Leaves wide, 1/5 or less of the width at half way up obscured by costa and lamellae; lamellae 2-6 cells high, or up to 13 in *A. undulatum* var. *Selwyni*.

E. Costa and its lamellae at half way up obscuring 1/11-1/7 of the leaf width.

F. Lamellae low, 2-6 cells high.

G. Setae 1 from a tip or rarely a tip with 2, terminal; antheridia and archegonia at least usually on separate tips 2. *undulatum*.

GG. Setae 2-6 from a tip or rarely a tip with only 1, apparently lateral through their persistence and the renewed growth of the stem tip; usually the antheridia central with archegonia in a circle around them 2a. *Var. Haussknechtii*.

FF. Lamellae at their highest part reaching 6-13 cells 2b. *Var. Selwyni*.

EE. Costa and its lamellae at half way up obscuring 1/7-1/5 the leaf width; leaves short 2c. *Var. minor*.

- DD. Leaves narrow, $1/4-2/3$ of the width at half way up obscured by costa and lamellae; lamellae 7-14 cells high at highest point.
- H. Lamellae 4-8, 7-9 cells high at highest point; costa and lamellae obscuring $1/4-1/3$ of the leaf width at half way up; capsule curved. . . 3. *angustatum*.
- HH. Lamellae 7-12, 8-14 cells high at highest point; costa and its lamellae obscuring $1/2-2/3$ of the leaf width at half way up; capsule nearly straight. . . 3a. Var. *plurilamellatum*.
- AA. Leaf cells finely papillose.
- I. Capsule long, 3.5-6 mm.; teeth of the peristome about 200 μ long, from a basal membrane about 100 μ high; median cells of the leaf base 45-50 x 100-150 μ . . . 4. *papillosum*.
- II. Capsule short, 1.5-2.5 mm.; teeth of the peristome about 100 μ long, from a basal membrane about 50 μ high; median cells of the leaf base 12-17 x 19-43 μ . . . 5. *Macmillani*.

1. ATRICHUM CRISPUM (James) Sull., in A. Gray, Man. (Ed. 2) 641. 1856.

Catharinea crispa James, Proc. Acad. Nat. Sci. Philadelphia 7: 445. 1855.

Catharinea crispa var. *densifolia* Lindb., Not. Saellsk. Fauna Fl. Fenn. 9: 149. 1867.

Atrichum crispum var. *densifolium* Paris, Index Bryol. (Ed. 1) 52. 1894.

Plants gregarious, small or mediumly robust, dull or yellowish-green, brownish when old; stems simple, from a branched rhizomatous base, 1-3-5 cm. long, distantly leafy, bracteate below, with rhizoids at base; leaves crispate when dry, spreading when moist, without sheath, *oval-oblong or lanceolate-oblong*; larger leaves 4-5 mm. long, 0.9-1.1 mm. wide, 4-5 times as long as wide, *not or hardly undulate*; lamina *not toothed on back*, 1 cell thick; apex obtusely acuminate, often ending in a tooth like the marginal ones; margin serrate in the upper $1/2-2/3$, its teeth largely single but some double on each side; leaf border of long narrow cells from very near base to tip, 1-3 cells wide, 1-2 cells thick, its cells with thick walls; costa percurrent or excurrent, at the leaf middle 90-105 μ wide and constituting $1/11-1/10$ of the leaf width, occasionally with a tooth on the back near the apex, *with lamellae on upper side from the apex to below middle, or some leaves without them*; lamellae 0-4, frequently interrupted, 1-3 cells high, entire, smooth, not undulate, the marginal cells like the others and not incrassate; leaf cells at $3/4$ up 20-45 μ in longest diameter, quadrate-hexagonal to roundish, smaller toward the margin, inclined to be longer transversely; those of the median base rectangular, 1-3 times as long as wide; those of the marginal base narrower. Leafy stems dioicous; male plants taller, in separate clusters; calyptra 3.5-4 mm. long, cleft to about the middle, quite hispid at tip; setae 14-21 mm. long, smooth, usually 1 but occasionally 2-3 from the same tip; capsule terete, erect or nearly so, slightly curved, gradually narrowed at base; urn 2-3.5 mm. long, 600-700 μ wide at the mouth, 3-4.5 times as long as wide, longitudinal walls of the epidermis incrassate; stomata wanting; lid conic, beaked, the beak about half as long as the urn; teeth of the peristome 32, simple, unequal, 160-200 μ long, 31-34 μ wide, 5-6 times as long as wide; basal membrane projecting only about 0.1 the length of the teeth; spores 16-22 μ , smooth. Type locality, Camden, New Jersey (James).

ILLUSTRATIONS:—Sull. Icones Musc. pl. 46; Braithw. Brit. Moss Fl. 1: pl. 5C; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) pl. 5B; Proc. Wash. Acad. Sci. 12: 277. f. 1; M. H. M. pl. 7; Pl. 53A.

EXSICCATI:—Aust. Musci Appal. 231; Grout, N. Am. Musci Perf. 162, 316, Hand-lens Mosses 8, Bryol. Distrib. Mosses 30; Holz. Musci Acro. Bor. Am. 99; Macoun, Can. Musci 464 (as *Catharinea xanthopelma*), 567; Sharp, Fl. Tennessee Bryo. 35331; Sull. & Lesq. Musci Bor. Am. 209b.

On banks of streams and on moist soil. Vermont, New York, Ontario and southward to Tennessee; British Columbia; Oregon.

The various collections differ considerably in the maximum and minimum dimensions of the leaf cells. The variety *densifolia* is believed to be a form growing under difficulties. The leaves of all species of *Atrichum* grade into bracts downward on the stem. The bracts have less development of lamellae, and are wider in proportion to their length than the larger leaves. The largest leaves on the variety compare very well with the smaller leaves of *A. crispum* which are on the region of the stem where gradation into bracts is evident. If a plant of *A. crispum* grew under difficulties so its stem ceased to grow before forming its largest leaves, it would be the variety.

Of this variety the material examined was collected by A. Richards at Oakmere, Cheshire, England, in 1910; and by A. J. Sharp on Mt. LeConte, Tennessee, October 2, 1932. Braithwaite, in *British Moss Flora* 1: 42, 1887, says the fertile plant has been found only in North America. We have seen no capsules. However, the variety was erected on the leafy plant and not on the capsule.

1a. Var. MOLLE (Holz.) n. comb.

Catharinaea mollis Holz. Musci Acro. Bor. Am., No. 48. 1904.

Stems 1-2 cm. long, proliferous through the antheridial disk; leaves lingulate-lanceolate, not undulate, up to 2-3.5 mm. long, 750-850 μ wide, 2-4 times as long as wide; apex acute; margin commonly serrate in the upper 1/4-1/2; the teeth short, or on some leaves wanting or few; cells at 3/4 up 17-24 μ in longest diameter, almost isodiametric but rather longer transversely; lamellae 2-5, 4-8 cells high, entire or slightly crenulate. Type locality, Marshland, Wisconsin (J. M. Holzinger) June, 1903. *Pl.* 53, *figs.* 11-13.

EXSICCATI:—Holz. *l. c.*

Examined:—Manatee, Florida (Grout & MacFarlin 435) 1931.

On moist soil. Wisconsin; Florida.

The smooth leaves, wider above the base, and with weak marginal teeth place it with *A. crispum* rather than with *A. undulatum*. It differs from *A. crispum* however in the smaller cells, the higher lamellae, and the weaker development of marginal teeth. The description of the plant is printed on the label in Holzinger's exsiccati.

2. ATRICHUM UNDULATUM (Hedw.) Beauv. Prodr. 42. 1805.

Polytrichum undulatum Hedw. Sp. Musc. Frond. 98. 1801.

Catharinaea undulata Web. & Mohr, Ind. Mus. Pl. Crypt. 1803.

Oligotrichum undulatum Lam. & De Cand. Fl. France (Ed. 3) 2: 492. 1805.

Catharinaea Ehrharti Voit. Musc. Frond. & Herbiopolitano 17. 1812.

Callibryum undulatum Zenk. & Dietr. Musc. Thuringici, No. 41. 1822.

Catharinaea callibryon C. Muell. Syn. Musc. Frond. 1: 192. 1849.

Plants dark-green, quite vigorous for the genus; stems up to 8 cm. long, simple or rarely branched, with a polytrichoid central strand, leafy above, bracteate below; leaves crispate, widely spreading when moist, unsheathed, rather distant; largest leaves 5-9 mm. long, 1-1.3 mm. wide, ligulate, bordered, serrate; lamina undulate, with teeth on back on the undulations, 1 cell thick but 2 at the insertion; apex acute, often ending in a tooth like the marginal ones; margin serrate from the base or nearly there to the tip; teeth largely double, coarse, incrassate; border along the upper 4/5-9/10 or disappearing between the teeth near the tip, 1-3 cells wide, mostly 2 cells thick, of long narrow cells with thick walls; costa percurrent or barely vanishing, 70-110 μ wide near middle and constituting 1/9-1/10 the median leaf width, or with its lamellae obscuring 1/7-1/11 the median leaf width, with a few teeth on back near tip, lamellose on upper side; lamellae 2-6, on the upper 1/2-3/4 of the leaf, 2-6 cells high, entire, not undulate, grading into costa below, composed of broken longitudinal rows of cells, the marginal smooth like others; leaf cells at 3/4 up in somewhat broken longitudinal rows, mostly 4-6-sided, often the transverse diameter the longer, smooth, 18-40 μ in longest diameter; those of the base midway between the costa and margin 2-3 times as long as wide; those of the marginal base 6-10 times as long as wide; bracts of the lower stem shorter than the leaves, wider for their length. Leafy plants polyoicous, at least some stems bearing only antheridia the first year and only archegonia in succeeding years; calyptra rough at tip but not hairy, covering about 1/3 the capsule; setae 1 or rarely 2-3 from the same tip, 2-4 cm. long, straight, reddish, smooth, hollow; capsule terete, inclined, cylindric, gradually narrowed at base, without stomata; urn 4-5 mm. long, 700-800 μ thick, slightly curved, sometimes shorter and almost regular, its epidermis with strongly incrassate longitudinal walls; lid almost as long as the body of the capsule, rostrate from a hemispheric base; teeth 32, single, 220-320 μ long, 50-80 μ wide, 4-5 times as long as wide, from a basal membrane 80-100 μ wide; spores 9-23 μ , almost smooth. Type locality, European.

ILLUSTRATIONS:—B. S. G. Bryol. Eur. *pl.* 410; Braithw. Brit. Moss Fl. 1: *pl.* 5B; Proc. Wash. Acad. Sci. 12: 279. f. 3; Jennings Man. Mosses W. Pennsylvania *pl.* 26; Grout Mosses W. H-lens *pl.* 14; *Pl.* 53 B. (including varieties).

EXSICCATI:—Allen, Mosses Cascade Mts. 76; Aust. Musci Appal. 230; Frye, Bryo. Olympic Mts. 581; Grout, N. Am. Musci Perf. 265, Hand-lens mosses 9; Holz. Musci Acro Bor. Am. 72 (mixed with some *A.*

Macmillani), 72b; Macoun, Can. Musci 216, 563; Sull. & Lesq. Musci Bor. Am. 208; U. S. Soils Exped. Alaska 833; Drumm. Musc. Am. 67, 285 those plants with large capsules.

On clayey soil. Newfoundland to Alaska, southward to California and South Carolina; Europe; Asia; Africa.

Plants from the Rocky Mts. and westward have larger leaf cells on the average than those of the Mississippi Valley and eastward, and often larger leaves. Plants in a region where the humidity is high most of the time seem to have larger leaves with larger leaf cells.

2a. Var. *HAUSSKNECHTII* (Jur. & Milde) n. comb.

Atrichum Haussknechtii Jur. & Milde, Verh. K. K. Zool.-Bot. Gesel. Wein 598. 1870.

Catharinea Haussknechtii Broth. Etud. Distrib. Mouss. Caucase 4. 1884.

Catharinea undulata var. *Haussknechtii* Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 1) 500. 1896.

Catharinea anomala Bryhn, Bot. Not. 157. 1886.

Catharinea lateralis Vaiz., Ann. Bot. 2: 69. 1888.

Atrichum fertile Naw., Hedwigia 28: 359. 1889.

Paroicous; antheridia central; their bracts suddenly acuminate, almost entire; archegonia a row external to the antheridia; *setae* 2-6 from the same tip, persistent for a year or two, becoming apparently lateral through innovation from the antheridial tip. Type locality, European.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. 2: pl. 84A.

EXSICCATI:—Macoun, Can. Musci 563a; Drumm. Musc. Am. 660.

Examined: Friday Harbor, Washington (Foster) 1904.

On soil. Nova Scotia; British Columbia; Washington; Europe; Asia.

The variety *Haussknechtii* is sometimes spelled with one "s" and at others with two. We do not have access to the original description and thus cannot say definitely which is correct.

2b. Var. *SELWYNI* (Aust.) n. comb.

Atrichum Selwyni Aust., Bot. Gaz. 2: 95. 1877.

Catharinea Selwyni E. G. Brit., Bull. Torr. Club 16: 110. 1889.

Catharinea rosulata Kindb. Eur. & N. Am. Bryin. 153. 1897.

Atrichum undulatum var. *allecristatum* Ren. & Card., Bot. Gaz. 15: 58. 1890.

Lamellae 6-13 cells high. Type locality, West Coast of North America.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. 12: 280. f. 4.

EXSICCATI:—Holz. Musci Acro. Bor. Am. 373; Macoun, Can. Musci 6B, 216, 565; Sandberg, Pls. N. Idaho 1152.

On clayey soil in damp places, usually in mountains. Pennsylvania, Ohio, Michigan, Missouri, Kansas, Alberta, British Columbia, Montana, Idaho, Washington, Oregon, Colorado.

The variety like the species is variable in size of leaf and of leaf cell, but has higher lamellae. *A. Selwyni* Aust. is the vigorous plant of humid regions with higher lamellae, while *A. undulatum* var. *allecristatum* Ren. & Card. is the smaller form of less humid atmosphere with higher lamellae. Of the latter the material examined was not the type, but was Sandberg's Plants of N. Idaho, No. 1152, kindly lent by the University of Minnesota.

2c. Var. *MINUS* (Lam. & De Cand.) Web. & Mohr Bot. Tasch. 217. 1807.

Oligotrichum undulatum var. *minus* Lam. & De Cand. Fl. France (Ed. 3) 2: 492. 1805.

Catharinea undulata var. *corsica* DeNot. Syll. Musc. 169. 1838.

Atrichum undulatum var. *abbreviatum* Schimp., B. S. G. Bryol. Eur. 21-22: 8. 1844.

Catharinea undulata var. *abbreviata* Rabenh. Deutsch. Krypt. Fl. 23: 233. 1848.

Catharinea callibryon var. *abbreviata* C. Muell. Syn. Musc. Frond. 1: 193. 1849.

Catharinea undulata var. *allegheensis* Jennings, Man. Mosses W. Pennsylvania 188. 1913.

Stem, leaves, seta and capsule all shorter than in the type; leaves narrower; lamellae obscuring 1/7-1/5 the leaf width about the middle. Type locality, European.

ILLUSTRATIONS:—Jennings, Man. Mosses W. Pennsylvania pl. 27.

EXSICCATI:—Holz., Musci Acro. Bor. Am. 529.

On rather dry soil. Pennsylvania; Kansas; Washington; Europe; Asia.

This seems to be merely a depauperate condition of the plants. However, there is an element of uncertainty, and thus it seems best to keep it separate. Examination of type material of Jennings' var. *allegheniensis* leaves no doubt in mind about its position as here given.

3. *ATRICHUM ANGUSTATUM* (Brid.) B. S. G. Bryol. Eur. 21-22: 9. *pl.* 411. 1844.

Polytrichum angustatum Brid. Sp. Musc. 1: 79. 1806.

Polytrichum cylindricum Sw., Muehl. Cat. Pl. Am. Sept. 99. 1813.

Catharinea angustata Brid. Mant. Musc. 4: 204. 1819.

Atrichum ligulatum Mitt., Kew Misc. 1857: 262. 1857.

Catharinea xanthopelma C. Muell. Flora 56: 482. 1873.

Atrichum xanthopelma Jaeg. & Sauerb. Adum. 1: 705. 1873-1874.

Plants gregarious, dark olive-green, reddish brown when old, mediumly robust; stems mostly simple, from a branched rhizomatous base, erect, up to 5 cm. long, grooved, leafy above, bracteate below, with rhizoids from the lower part; leaves crispate when dry, erect to divergent at 45° when moist, grading to mere bracts below; larger leaves 3-4.5 mm. long, 600-750 μ wide at widest part, linear-lanceolate, bordered, toothed; *lamina* undulate, with few to many teeth on the undulations on the back, 1 cell thick; apex bluntish acute, ending in a tooth similar to those of the margin; marginal teeth along the upper 1/2-1/3, incrassate, from very few to most of them double; border extending from the base or near it to the tip or near it, 2 cells wide and 2 cells thick where well developed, of long narrow cells with thick walls; costa percurrent or barely vanishing, 73-103 μ wide about the middle, constituting 1/6-1/7 the median leaf width, or with its *lamellae* obscuring 1/3-1/4 the median leaf width, toothed on back near tip, lamellate on the ventral side; lamellae 4-7, on about the upper 3/4 of the leaf, 7-9 cells high at their highest region, entire, composed of discontinuous longitudinal rows of cells, the marginal ones smooth like the others; leaf cells at 3/4 up in somewhat broken longitudinal rows, roundish-hexagonal, often longer transversely, 10-15 μ in longest diameter, smooth; cells near base midway between costa and margin rectangular, 1.5-2.5 times as long as wide; marginal basal cells narrower for their width; bracts of the lower part of the stem shorter than the leaves, wider for their length. Dioicous; calyptra about 4 mm. long, hispid at tip, split about 1/3 of its length; setae usually only 1 per tip, 1-2 cm. long, straight, smooth, hollow; capsule terete, almost erect, narrowly cylindrical, straight or nearly so, without stomata, gradually narrower at base; urn about 2.5-6 mm. long, 500-800 μ in diameter, 4-8 times as long as wide, its epidermal cells with incrassate longitudinal walls; lid hemispheric, rostrate, 2-2.5 mm. long, roughly half the length of the urn; peristome teeth 32, single, 145-300 μ long, 30-45 μ wide, 4.5-7 times as long as wide, from a basal membrane about 50 μ high; spores 10-14 μ , almost smooth. Type locality, European.

ILLUSTRATIONS:—B. S. G. Bryol. Eur. *pl.* 411; Hedw. Descrip. 1: *pl.* 17, *f.* 14-18; Jennings, Man. Mosses W. Pennsylvania *pl.* 27; Proc. Wash. Acad. Sci. 12: 278. *f.* 2; *Pl.* 54A; Drumm. Musc. Am. 68, 285 (plants with smaller capsules).

EXSICCATI:—Aust. Musci Appal. 228, 229; S. L. Clarke, N. Am. Mosses 440; Grout, Hand-lens Mosses 7, N. Am. Musci Perf. 20; Holz. Musci Acro. Bor. Am. 122, 430 (one of two packages examined); Macoun, Can. Musci 564; Small, Georgia Mosses 9557, 9564; Sull. & Lesq. Musci Bor. Am. 209.

On sandy soil in shade. Newfoundland, Nova Scotia, New Brunswick, Ontario, Wisconsin and Minnesota, southward to Texas, Louisiana and Florida; Europe; Asia.

A. xanthopelma is a form found in the southeastern part of the U. S. and has fewer double teeth. It was described as having teeth single, but it is difficult to find a leaf without some double teeth, and there is no line of demarcation on that basis. The capsules average smaller, but there is again no definite separation. Its teeth are weaker in the more marked form. Single teeth in *Atrichum* are found at points where the margin is only one cell thick.

3a. Var. *PLURILAMELLATUM* (Jennings) n. comb.

Catharinaea plurilameolata Jennings, Man. Mosses W. Pennsylvania 191. *pl.* 27. 1913.

Leaves narrower above the sheath, the *lamellae* obscuring 1/2-2/3 of the median leaf width; lamellae 7-12, 8-14 cells high. Type locality, Ohio Pyle, Fayette County, Pennsylvania (O. E. and Grace E. Jennings) September 10, 1905. (About lat. 39° 53' N., long. 79° 29' W.) *Pl.* 54A. *figs.* 22-24.

ILLUSTRATIONS:—Jennings *l. c.*

Examined:—Co-type material.

On shaded banks. Pennsylvania.

Papillose plants of this should be referred to *A. papillosum*. Possibly those not papillose should be referred to *A. angustatum*, but until we know more about the range and the limits of variation it seems best to keep it distinct as a variety.

4. ATRICHUM PAPILLOSUM (Jennings) n. comb.

Catharinaea papillosa Jennings, Man. Mosses W. Pennsylvania 190. pl. 27. 1913.

Plants loosely caespitose, dark-green; stems simple or at the base sparsely branched, towards the base radiculose, erect, about 2 cm. high, chestnut-brown to purple; leaves crispate and circinate when dry, erect or erect-spreading when moist, gradually longer up the stem, grading into bracts below; the upper leaves tufted, oblong-linear, 3-5 mm. long, 700-1000 μ wide, bordered, toothed; lamina somewhat undulate, with some strong teeth on the undulations, 1 cell thick; apex obtuse to acute; border of elongate cells from near base, sometimes disappearing between the teeth near the tip, mostly 2-3 cells wide and 2 cells thick; marginal teeth in the upper $1/2-1/3$ more or less double; costa percurrent, coarsely few-toothed on back near tip, constituting $1/6-1/4$ the median width of the leaf, or with its lamellae obscuring $1/5-1/3$, lamellate on the upper side; lamellae 4-8, mostly 6-14 cells high, entire, not undulate, composed of broken longitudinal rows of cells minutely and sparsely papillose at least along the margin; leaf cells at $3/4$ up slightly minutely papillose on both sides, often wider than long, 8-15 μ in longest diameter; those of the median region of the sheath 45-50 μ wide and 100-150 μ long. Dioicous, or rarely the archegonia on an innovation from an antheridial tip of the preceding year; antheridial bracts abruptly linear-acuminate from an ovate-orbicular concave base, about 2 mm. wide and 3 mm. long, canaliculate toward the apex, sparsely papillose; perichaetial leaves similar to the stem leaves; calyptra about 5 mm. long, narrowly cucullate, not extending to the base of the capsule, slightly hairy toward tip; setae 1 or rarely 2, erect, flexuous, often slightly twisted to the left, about 2 cm. long, smooth, chestnut-brown; capsule linear-cylindric, 3.5-6 mm. long, 500-700 μ in diameter, erect-arcuate; urn tapering abruptly at the base, smooth, chestnut brown; epidermal cells of the urn rectangular, their lateral walls much incrassate, in a series of 5 or 6 cells under the mouth smaller, quadrate, darkly incrassate; peristome teeth 32, linear-oblong, about 200 μ high, in the median line reddish orange, towards the sides hyaline, in the margins a little dark and densely although minutely papillose; basal membrane about 100 μ high; spores 8-11 μ , smooth, somewhat orange; lid subulate from a hemispheric base, shining, dark chestnut-brown; its beak about 1.8 mm. long. Type locality, West end of Fern Hollow Bridge, Pittsburgh, Pennsylvania (Jennings) March 8, 1908.

ILLUSTRATIONS:—Jennings, l. c.; Pl. 54B.

Examined:—Co-type material.

On banks. Pennsylvania.

It differs from *A. angustatum* chiefly in that its leaves are finely papillose and the lamellae slightly higher. Only papillose plants should be referred here, since the lamellae alone are not sufficient to warrant a new species. The papillosity is very similar to that in *A. Macmillani* but is not figured by Jennings. See comments after *A. Macmillani*.

5. ATRICHUM MACMILLANI (Holz.) n. comb.

Catharinaea Macmillani Holz., Minnesota Bot. Studies 3²: 120. pl. 19. 1903; (sterile). Chamberlain, Rhodora 9: 99. pl. 75. 1907; (fertile).

Plants dull-olive, or when old reddish-green, brown below; stems from a rhizomatous base, simple or branched below, erect, up to 2.5 cm. long, with some rhizoids from the lower part; leaves crispate and somewhat spirally contorted when dry, erect-patent when moist, linear-oblong, grading into bracts below; larger leaves 2-3 mm. long, about 500 μ wide, bordered, toothed; lamina somewhat undulate in the upper third, with several rows of strong dorsal teeth on the undulations, 1 cell thick; apex acute, often ending in a tooth like the marginal ones; margin bordered with elongate cells from near the base, toothed in the upper half or third; border often evanescent between the teeth above, mostly 2 cells wide and 2 cells thick; teeth incrassate, about $1/3$ of them double; costa percurrent, semiterete, constituting $1/6-1/5$ the median width of the leaf, or with its lamellae $1/4-1/3$, toothed on back near tip, lamellate on the upper side; lamellae 4-8, disappearing $1/5-1/4$ up from the leaf base, 6-12 cells high, entire or minutely crenulate, not undulate, composed of broken longitudinal rows of cells, the marginal cells with 2-3 small papillae but hardly otherwise thickened, cells at $3/4$ up round to hexagonal, often wider than long, 8-15 μ in longest diameter, usually with 1-3 low papillae on the dorsal surface, with fewer to almost none on the ventral; cells near leaf base midway between

costa and margin rectangular, 19–43 μ long, 12–17 μ wide, basal marginal cells narrower for their length. Dioicous; archegonia in the axils of the inmost leaves; calyptra cucullate, rough at apex, equaling the urn; setae 1 or rarely 2, 30–50 mm. long, terete, brownish; capsule cylindric; the urn 1.5–3 mm. long, 500–600 μ wide, erect, straight or slightly curved, smooth; its epidermal cells longitudinally incrassate, the upper 5–6 cells below the mouth with the transverse walls also incrassate; teeth 32, linear, 19–21 μ wide, 96–100 μ long, 4.5–5 times as long as wide, occasional ones double, acute, with some papillae, rough at margin, from a basal membrane half as long; spores 8–15 μ , smooth. Type locality, Ortonville, Minnesota.

ILLUSTRATIONS:—As mentioned under the name; *Pl.* 54C.

EXSICCATI:—Holz. Musci Acro. Bor. Am. 72 (as *Catharinea undulata* has this intermingled as the smaller plants), 249, 430 (as *Catharinea xanthopelma*, although of two packages of this number examined one was correctly named, while the other was *A. Macmillani*), 528; Rapp, Florida Mosses 19.

Examined:—Winter Park, Florida 1936 and Hartsville, South Carolina 1931 (Grout).

On dry sterile soil. Maine to Minnesota, southward to Missouri and Florida.

This is not as distinctive a species as one might conclude from the description and figures, and thus has escaped recognition about as often as any, probably because the papillae are less easily seen than one might conclude from the figures. They are most easily seen with a magnification of 500 or more diameters in a cross section from the upper half of the leaf, and are much more abundant on the dorsal than on the ventral side. It is distinguished from *A. papillosum*, its nearest relative, by the sporophyte. *A. Macmillani* has a much shorter seta, and a shorter urn of the capsule as well as shorter teeth. However the lid and calyptra are of about the same length as in *A. papillosum*. The two are about equally papillose. Perhaps *A. Macmillani* is merely a depauperate form of *A. papillosum*, but the collections of both are too limited to enable one to reach a conclusion. For that reason they are kept separate.

2. OLIGOTRICHUM Lam. & De Cand. Fl. France (Ed. 3) 2: 491. 1805.

Psilopilum Brid. Bryol. Univ. 2: 95. 1827.

Plants green to yellowish-green, brownish when old, gregarious or in loose sods, often firm in texture; stems slender to stout, usually of medium height, arising from creeping subterranean rhizomes, scaly below, leafy above; central strand not polytrichoid, not sharply defined; rhizoids from base of stem; leaves more or less close, grading below into smaller and smaller scales; larger leaves more or less spreading from an erect sheath-like base, sometimes almost tubular at tip through the involute leaf margins, sometimes keeled, lanceolate to oblong or lingulate; dry leaves applied to the stem, sometimes slightly crispate, with apex curved toward the stem; margin not bordered with elongate cells; lamina not or little undulate, 1 cell thick, rarely with a few teeth at back, sometimes with dorsal and ventral lamellae; costa vanishing to excurrent as a tooth, lamellae sometimes present on dorsal side near apex and in some species extending down to the sheath-like base, always with lamellae on the ventral side; dorsal lamellae of costa straight, usually serrate and low, in most cases not extending very far down; ventral lamellae of costa wavy from side to side in most species, entire to crenulate, of smooth cells, the marginal cells like the others; leaf cells thick-walled, quadratic to roundish-hexagonal or wider than long in upper part, rectangular, the lower poor in chlorophyll. Dioicous; male inflorescence terminal, cup-like to saucer-shaped, innovating from the center; female inflorescence terminal; calyptra cucullate, with sparse erect hairs or rarely naked or matted hairy; setae solitary; capsules erect to inclined, regularly terete or slightly laterally compressed, ovoid to subcylindrical, straight to strongly arcuate, rather abruptly narrowed to the seta, with stomata at base; stomata very large, with 2–4 guard cells; epidermal cells of the urn smooth; spore sac separated from the wall all around by an air space containing filamentous tissue, outwardly terete, inwardly with 4 deep grooves and thus the thin columella apparently 4-winged; teeth of peristome usually unequal in size, uniformly light in color; lid readily falling off, conic, with the terminal projection varying from a mere point to a long thin beak.

There is no character which can be relied upon at present to distinguish *Oligotrichum* from *Psilopilum*. Among the species commonly referred to these two genera, the prime character upon which to base a sub-grouping is the presence or absence of the peristome. However, the type species of the genus *Psilopilum* has a peristome, as does that of *Oligotrichum*.

KEY.

Leaves coarsely toothed, soft, pliable; lamina as well as costa often with conspicuous lamellae on back.

Lamellae of the ventral side of the costa straight or nearly so, entire or nearly so;

lamina with lamellae only near the tip or none at all 1. *parallelum*.

- Lamellae of the ventral side of the costa wavy from side to side, coarsely serrate; lamina with lamellae down to the sheath-like leaf base. 2. *aligerum*.
- Leaves rather finely toothed to entire, rather stiff and rigid; lamina rarely with some suggestions of lamellae on back, though nearly always present on back of costa.
- Transverse walls of the marginal and submarginal cells approaching the margin at about right angles; leaf margin not hyaline. 3. *hercynicum*.
- Transverse walls of the marginal and submarginal cells approaching the margin diagonally forward, the marginal 1 or 2 cells hyaline at least in parts.
- Leaves erose-dentate. 4. *laevigatum*.
- Leaves entire to finely dentate. 4a. var. *cavifolium*.

I. OLIGOTRICHUM PARALLELUM (Mitt.) Kindb. Eur. & N. Am. Bryin. 156. 1897.

Atrichum parallelum Mitt. Jour. Linn. Soc. London 8: 48. 1865.

Atrichum leiophyllum Kindb. Bull. Torr. Club 17: 275. 1890.

Oligotrichum leiophyllum Kindb. Eur. & N. Am. Bryin. 156. 1897.

Plants loosely caespitose, dark-green; stems simple, short, erect, 1.5-4 cm. long, scaly below the leaves; rhizoids from lower part of stem only; lower scales of the stem about as wide as the stem, ovate, entire, acute, without lamellae; scales grading upward into the leaves; larger leaves spreading when moist, *crispate* when dry, oval to ligulate-oval, 3-4.2 mm. long, 1-1.5 mm. wide, not or little undulate, with lamellae on both sides on the costa; lamina with an occasional small lamella on the back and sometimes with a few tooth-like processes; margin serrate from tip to about the middle or more; *marginal teeth coarse, sharp*, the upper composed of 2-4 cells and grading into the smaller lower ones of not over 1 cell; apex acute; costa percurrent to excurrent as a tooth; *lamellae of ventral surface 4-6, not wavy from side to side*, up to 6-7 cells high, *entire*, their cells in distinct longitudinal rows, the marginal cells like the others; *dorsal lamellae 2-4, on costa near tip*, dentate above, crenate below; median leaf cells at 3/4 up roundish to angular, isodiametric or wider than long, not thick walled, 10-22 μ ; those of the margin about the same or with somewhat thicker walls for a few rows; basal cells rectangular, 40-51 μ long, 10-21 μ wide. Inflorescences terminal; male plants smaller, the inflorescence cup-shaped, rejuvenating through the center; bracts ovate or obovate, some of them cuspidate, 1-1.5 mm. long; perichaetial leaves convolute at base, gradually narrowed, lanceolate; calyptra cucullate, with few erect hairs on upper half, with short papilliform hairs at tip; setae solitary smooth, brown, mostly slightly twisted to the right above, 2.5-3 cm. long; capsule subcylindric, only slightly ventricose below, slightly arcuate, verrucose; urn 4-5 mm. long, 1.1-1.3 mm. thick below, narrowed to about 0.9-1 mm. below mouth, with stomata near base; stomata cryptopore, with 2 guard cells, the slit rather narrow; epidermal cells of urn rectangular, 55-90 μ long, 13-26 μ wide; the first few cells below the mouth wider than long, grading into the normal ones; lid rostrate from a conic base, about 900 μ wide, the beak about 550 μ long; teeth 32, often showing tendency to divide, 150-190 μ long, 85-90 μ wide, rough but not or only very finely papillose on outer side, not papillose on inner side; basal membrane 150-160 μ high; spores 12-17 μ , brownish, smooth. Type locality, Grande Cote, Rocky Mountains (Drummond). Grande Cote is probably merely the general Pacific Coast region, the name Rocky Mountains being applied to the whole western cordillera.

ILLUSTRATIONS:—Jour. Linn. Soc. London 8: *pl.* 8; Sull. Icones Musc. Suppl. *pl.* 38; Proc. Wash. Acad. Sci. 12: 283. *f.* 5; *Pl.* 55A.

EXSICCATI:—Drumm. Musci Bor. Am. 286 (as *Polytrichum undulatum*); Holz. Musci Acro. Bor. Am. 199, 269, 658; Macoun, Can. Musci 568, 569 (as *Atrichum leiophyllum*); U. S. Soils Kelp Exped. Alaska 1227.

On rocks and soil in mountainous regions. Alaska to Washington; Norway.

O. parallelum is much more variable in its leaves than was supposed when it was described. The lamellae vary in height on the same plant and in different localities. The more lush it grows the more its leaves tend to elongate and thus approach the lingulate form. The teeth and lamellae on the lamina may or may not be present on leaves of the same plant. The longitudinal stripes on the lamina of *O. parallelum* mentioned by Kindberg in Eur. and N. Amer. Bryineae 156, are merely low lamellae and may or may not be present. Since these constitute the chief characters on which *O. leiophyllum* is based, it is a synonym of *O. parallelum*, as Cardot & Thériot decided (Proc. Wash. Acad. Sci. 4: 326, 1902). The lower portion of the leaf sometimes shows 1-2 rows of marginal cells up to twice as long as wide, while those just interior to them

may be wider than long. This suggestion of a border is the nearest approach to *Atrichum* of any North American species of *Oligotrichum*.

2. *OLIGOTRICHUM ALIGERUM* Mitt. Jour. Linn. Soc. London 8: 48. pl. 8. 1865.

Plants loosely caespitose or gregarious, green, or brown to black when dry; stems simple, short, slender, erect, 1-3 cm. long, scaly below, leafy above; rhizoids rather abundant, at base of stem; lower scales of the stem about as wide as the stem, about as wide as long, ovate, entire, without lamellae, gradually grading into the leaves upward; the larger scales with lamellae on both sides of costa and lamina, with some teeth toward tip; larger leaves spreading or ascending when moist, *crispate when dry*, lanceolate from a sheath-like base, slightly curved, 2.5-4.5 mm. long, 0.6-1.2 mm. wide, not papillose, with lamellae on both sides on lamina and costa; margin erect or incurved in upper $\frac{3}{8}$, serrulate from tip to about the middle; *marginal teeth small, distant, blunt*, nearly all of them composed of less than 1 cell which is sometimes slightly larger than the surrounding ones; apex acute to somewhat subulate; costa excurrent; *lamellae of ventral leaf surface 6-10*, specially *those on the costa wavy from side to side*, up to 5-7 cells high or those not on the costa lower, *distantly and bluntly serrulate*, extending down to the sheath, the marginal cells like the others except that the tooth cells are sometimes larger; ventral lamellae on the lamina mostly reduced to crests; *lamellae of the dorsal leaf surface 6-9*, straight or nearly so, up to 4-5 cells high, *extending nearly to leaf base*, coarsely serrate to the sheath; teeth distant, blunt, larger than those of the ventral lamellae and of the leaf margin, usually composed of about 1 whole cell which is often larger than the surrounding ones; median leaf cells at $\frac{3}{4}$ up roundish-quadrate or oval, rather thick walled, 7-12 μ , those of the margin about the same but often wider than long; cells near base rectangular, 13-35 μ long, 10-20 μ wide. Male plants about same size as the female, easily recognized by the wide bracts; antheridia among hair-like paraphyses; male tip proliferating through the center; male bracts ovate, brownish when old; female tip with few archegonia among hair-like paraphyses; perichaetial leaves more narrowed toward tip than the leaves; calyptra with few short erect hairs to $\frac{3}{4}$ down, the very tip prickly with papilliform hairs; setae solitary, smooth, often twisted to right above or sometimes to the left, 3-4 cm. long; capsules subcylindric, somewhat ventricose below, slightly arcuate, not papillose; urn 3-4.5 mm. long, 0.96-1.38 mm. thick below, narrowed to 545-770 μ slightly below the mouth, with stomata near base; stomata phaneropore, with 2 guard cells, the slit narrow; epidermal cells of urn rectangular or hexagonal, 1.5-3 times as long as wide, yellowish brown; the first few cells below the mouth of the urn wider than long, grading into those below, dark brown; lid about 1 mm. wide, depressed-conic, with beak about 1 mm. long; teeth 32, fairly regular, about 140 μ long and 70 μ wide, they and the basal membrane finely granulate, less so on the inner side; spores 8-10 μ , brownish, smooth. Type locality, Grande Cote, Rocky Mountains (Drummond). See type locality of *O. parallelum*.

ILLUSTRATIONS:—Jour. Linn. Soc. London 8: pl. 8; Sull. Icones Musc. Suppl. pl. 39; Proc. Wash. Acad. Sci. 12: 284. f. 6; Pl. 56A.

EXSICCATI:—Grout, N. Am. Musci Per. 128; Holz. Musci Acro. Bor. Am. 199 (but of two packages of 199 examined one is labelled correctly, the other as *O. parallelum*), 657; Macoun, Can. Musci 77, 571; Taylor, Pls. B. C. 156 (with some *Pogonatum capillare*); U. S. Soils Kelp Exped. Alaska 996; Drumm. Musc. Am. 16.

On clayey banks in mountains. Alaska to Oregon.

Sullivant, Icones Musc. Suppl. pl. 39 is misleading in some points. His figure 5 leaves one in doubt as to which arm of the bifurcate margin is the true leaf margin. From his figure 6 one concludes it is the lower because the upper does not reach the apex. Whether the areolation drawn beside his figure 6 is from the upper or the lower part of the bifurcate margin is not stated, but the teeth shown are more nearly those of the lower. Leaves examined under the microscope show clearly that the upper arm of the bifurcation is the margin; from this one is led to believe he has shown the areolation of the most lateral lamella on the under side. His figure 4 of the ventral side of the leaf also shows the dorsal arm of the bifurcate margin disappearing at tip, while in reality it is the margin at the tip, and therefore also downward.

3. *OLIGOTRICHUM HERCYNICUM* (Hedw.) Lam. & DeCand. Fl. France (Ed. 3) 2: 492. 1805.

Catharinea hercynica Ehrh. Beitr. 1: 190. 1787.

Polytrichum hercynicum Hedw. Stirp. Crypt. 1: 40. pl. 15. 1787; Sp. Musc. Frond. 94. 1801.

Catharinea sancta Brid. Mant. Musc. 4: 203. 1819.

Catharinea hercynica var. *sancta* Brid. Bryol. Univ. 2: 101. 1827.

Catharinea sudetica Presl., Brid. Bryol. Univ. 2: 106. 1827.

Oligotrichum incurvum Lindb., Hartm. Skand. Fl. (Ed. 9) 2: 45. 1864.

- Oligotrichum hercynicum* var. *latifolium* C. Muell. & Kindb., Macoun Cat. Can. Pls. 6: 149. 1892. Not
O. incurvum var. *latifolium* of Frye in Proc. Wash. Acad. Sci. 12: 286. f. 8 (1a-3a). 1910.
Oligotrichum integrifolium Kindb. Rev. Bryol. 21: 40. 1894.
Oligotrichum exiguum Stirt. Ann. Scot. Nat. Hist. 16: 173. 1907.

Plants glaucous-green to yellowish-green, or when old reddish-brown, not shining, in loose sods; stems 2-3 cm. long, erect or nearly so, simple, angular; in cross section the cells toward the center smaller, slightly collenchymatous; central strand not polytrichoid, not clearly bounded; leaves scale-like at base of plant, gradually larger upward on stem, somewhat spreading when moist, when dry erect with the tips curved toward the stem, *firm, hardly crispate*, not undulate, the larger ones linear-lanceolate from an oblong sheathing base, up to 4.5 mm. long and 2.5 mm. wide; apex bluntly pointed; *margin involute above* so the leaves are almost tubular to hardly so at all, not lighter in color; *with small distant teeth*, these sometimes quite coarse toward apex; costa well developed, its back with 2-5 rudimentary lamellae with coarse and rather distant serrations; *lamellae of upper side of leaf 8-12*, all on the costa, occupying about half the leaf width in the upper part, *undulate from side to side, 6-12 cells high*, the margin crenulate; their marginal cells similar to the others, not papillose; lamina 1 cell thick, mostly with some short lamella-like crenulations on the back, or quite smooth; leaf cells thick walled; *at $\frac{3}{4}$ up* quadratic or hexagonal, often wider than long, 10-15 μ , *at the margin the transverse walls approaching the margin almost at right angles*; cells of the base rectangular, 2-4 times as long as wide, with little chlorophyll; cuticle finely longitudinally striate. Male plants shorter; male inflorescence discoid, rejuvenating from the center; inner male bracts broadly obovate, with acute point, without lamellae; paraphyses filiform, or some longer and spatulate; antheridia curved; female inflorescence with short filiform paraphyses; vaginula clavate-cylindric; ocrea none; calyptra cucullate, reaching the middle of the urn, with scattered erect hairs; seta 1-3 cm. long, thick, reddish-yellow; toward upper end somewhat grooved, solid, twisted to the right; toward base terete, with cylindrical hollow; axis of seta a small central strand surrounded by a layer of large cells; central hollow surrounded by large radially elongated cells; cortical cells 2 layers, small, colored, thick-walled; foot hook-like at tip; capsule erect, or when empty inclined, ovate-cylindric, 3-4 mm. long, 1.5 mm. thick, straight, thin-walled, brownish, when dry somewhat plicate and contracted below the mouth, narrowed below to the seta, with stomata at base; stomata numerous, large, oval, 70-90 μ , of 2 or rarely 4 guard cells, phaneropore; their pores long, narrow; lid shortly beaked or merely pointed from a conic base, falling with the calyptra; beak about 275 μ long; columella 4-winged, epidermis of capsule smooth; its cells thin walled, longer than wide, 4-6-sided; those about the mouth for 5-8 transverse rows red, the upper disintegrating into single cells; peristome teeth and basal membrane whitish, delicate, not papillose; teeth 32-50, the excess over 32 arising from irregular longitudinal division, rather short but quite variable in length; basal membrane papillose, delicate, about 40 μ high, unequal; spores 10-15 μ , yellowish, smooth. Type locality, "Am Rehberg zwischen Andreasberg und Oderbrueck," Germany (Ehrhardt) 1780.

ILLUSTRATIONS:—Hedw. Stirp. Crypt. 1: *pl. 15*; B. S. G. Bryol. Eur. *pl. 413*; Braithw. Brit. Moss Fl. 1: *pl. 5D*; Husnot Musc. Gall. *pl. 77D*; Limpr. Laubm. 2: *f. 320*; Proc. Wash. Acad. Sci. 12: 285. *f. 7 and 8* (1-3); Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl. 5C*; Moenkem. Laubm. Eur. *f. 225a*; *Pl. 55B*.

EXSICCATI:—Frye, Bryo. Olympic Mts. 526; Holz. Musci Acro. Bor. Am. 542; Macoun, Can. Musci 661 (from Rogers Pass July 31, 1890, the type of *O. hercynicum* var. *latifolium*), also 577 as *Pogonatum dentatum* of same place and date.

Examined:—Sandon, British Columbia (*F. A. MacFadden 240*). Mt. Rainier, Washington (*O. D. Allen 15*).

On moist soil or on bare soil slopes in mountainous regions. Greenland; Alaska to Washington; Asia; Faroe Islands; Europe.

Much of the European material and more of the American examined has teeth on the leaves less distinct than figured in Dixon & Jameson's Student's Handbook of British Mosses. The var. *laxa* of Europe shows coarser serrations as a rule. It seems likely that under hard conditions the leaves have fewer and less distinct marginal teeth, the leaves remain shorter, and the dorsal lamellae are often not so well developed. However, no natural line of cleavage presents itself, and thus the var. *latifolium* C. Muell. & Kindb. is considered merely a form.

4. OLIGOTRICHUM LAEVIGATUM (Wahlenb.) B. S. G. Bryol. Eur. 21-22: *pl. 414*. 1844.

Polytrichum glabratum Wahlenb., Web. & Mohr Ind. Mus. Pl. Crypt. 1803; *nomen nudum*.

Polytrichum laevigatum Wahlenb. Fl. Lapp. 349. *pl. 22*. 1812.

Catharinea glabrata Hook. Tour in Iceland (Ed. 2) 1813.

Polytrichum marginatum Schwaegr. Suppl. 12: 329. 1816.

Catharinea laevigata Brid. Mant. Musc. 4: 162. 1819.

Psilopilum arcticum Brid. Bryol. Univ. 2: 95. 1827.

Oligotrichum glabratum Lindb. Musc. Scand. 12. 1879.

Psilopilum laevigatum Limpr. Laubm. 2: 602. 1895.

Psilopilum glabratum Holz., Bryol. 5: 80. 1902.

Plants gregarious or in loose sods, green to brownish; stems up to 2 cm. long; leaves appressed when dry, not crispate, ovate or obovate to long-elliptic, up to 4 mm. long and about 1 mm. wide; apex blunt, almost cucullate; margin broadly incurved above and in portions hyaline for 1 to several cells in width; costa 120–180 μ wide, percurrent to vanishing close to the tip; ventral lamellae 5–14, wavy from side to side, coarsely and irregularly toothed, 8–11 cells high in highest part, the marginal cells like the others; median leaf cells at $\frac{3}{4}$ up 16–24 μ , thin walled; those at margin a few rows narrower and somewhat elongate, their walls approaching the margin diagonally forward; basal leaf cells 3–4 times as long as wide. Male inflorescence cup-shaped; perichaetial leaves 3–4.5 cm. long, lanceolate from a sheathing base; calyptra cucullate, small, extending $\frac{1}{4}$ – $\frac{1}{3}$ down the urn; seta 1–2 cm. long, thin, sinuose when dry, reddish; capsule strongly curved, rusty-red, with age becoming blackish-brown, with rather small mouth, with stomata at base; stomata superficial, 60–70 μ ; epidermal cells of the urn wider than long below the mouth; those lower down rectangular, about 2–3 times as long as wide on the convex side of the urn, on the concave side some of them shorter and even wider than long; teeth unequal in length, 1.5–2.5 times as long as wide. Type locality, Northern Europe.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. 12: 289. f. 9; Engler & Prantl Nat. Pfl.-Fam. (Ed. 2) 11: 778, A–J; Pl. 56B.

EXSICCATI:—Macoun, Can. Musci 574.

Examined:—Clausen, northern Greenland (Berggren) 1870; Labrador (Breutel) 1851.

On peaty or sandy soil in mountains. Greenland; Arctic America; Asia; Europe.

4a. Var. CAVIFOLIUM (Wils.) n. comb.

Polytrichum laevigatum Hook. & Arn., Bot. Capt. Beechey's Voyage 133. 1841. Not of Wahlenb. Fl. Lapp. 349. pl. 22. 1812.

Polytrichum cavifolium Wils., Seem's Bot. Voyage Harald 44. 1852.

Catharinea tschutschica C. Muell., Hall in Bot. Centralb. 16: 93. 1883.

Oligotrichum tschutschicum Lindb. & Arn. Königl. Svenska Vetens.-Akad. Handl. 23¹⁰: 10. 1890.

Oligotrichum incurvum var. *latifolium* Frye, Proc. Wash. Acad. Sci. 12: 286. f. 8a–8c. 1910. Not *O. hercynicum* var. *latifolium* Kindb., Macoun Cat. Can. Pls. 6: 149. 1892.

Psilopilum tschutschicum Paris, Index Bryol. (Ed. 1) 1039. 1897.

Psilopilum cavifolium Hagen, Bryol. 19: 70. 1916.

Leaves not greatly crowded; lamina smooth; apex short-incurved, acute; margin quite entire; costa smooth on back, about 120 μ wide, with a strong dorsal stereid band; lamellae entire, leaf cells at $\frac{3}{4}$ up rather thick walled; those of the base rectangular, thin walled. Perichaetial leaves gradually narrowed to lanceolate from an oval base, about 3 mm. long; capsule slightly curved. Type locality, Kotzebue Sound, Alaska. (About lat. 67° N., long. 163° W.)

ILLUSTRATIONS:—Bryol. 5: pl. 8; Proc. Wash. Acad. Sci. 12: 287. f. 8a; Pl. 56B. figs. 12–14.

Examined:—St. Lawrence Island, Alaska (Macoun) Aug. 15, 1891.

On soil. Greenland, Yukon, Alaska, N. Europe; N. Asia; Iceland.

The variety *cavifolium* represents the extremely reduced form. In the extreme it has leaves entire, short, and without dorsal lamellae or crests. But the upper leaves often show abortive teeth or even fairly distinct lamellae, or both.

O. cavifolium var. *anomalum* Hag. and *O. laevigatum* var. *laxirete* C. Jens., from Greenland, seem to fall here, but we have not seen the plants.

3. LYELLIA R. Br. Trans. Linn. Soc. 12: 561. 1818.

Philocrya Hag. & Jens., Medd. om Groenland 15: 388. 1897.

Bartramiopsis Kindb., Rev. Bryol. 21: 35. 1894.

Plant stiff, gregarious, brownish-green; stems with polytrichoid central strand, simple, firm, erect, free from leaves to well up, leafy above; rhizoids near base of stem; leaves spreading, crispate when dry,

with a sheath-like base, not bordered with long cells; sheath wide, membranous; *lamina 2 cells thick for most of its area*, not undulate, margin serrate at least in upper part; costa percurrent or excurrent, toothed on back above, lamellose on ventral side; lamellae few to numerous, entire to crenulate or serrate. Dioicous; male inflorescence saucer-shaped, innovating from the center; *calyptra* cucullate, *smooth*; seta thick, stiff, solitary; capsules erect or suberect, becoming almost horizontal in some species, irregularly or regularly ovoid to oblong; neck hardly differentiated, *with stomata*; *peristome wanting*; lid rostrate from a conic base.

KEY

Lamellae 5-8, sharply serrate; leaves with cilia where sheath narrows to blade; costa smooth on back. 1. *Lescurii*.
Lamellae 24-30, entire to crenulate; leaves without cilia; costa toothed on back toward tip. 2. *aspera*.

1. LYELLIA LESCURI (James) n. comb.

Atrichum Lescurii James, Bull. Torr. Club 6: 33. 1879.

Bartramiopsis Lescurii Kindb. Rev. Bryol. 21: 35. 1894.

Bartramiopsis sitkana Kindb. Rev. Bryol. 21: 35. 1894.

Oligotrichum Lescurii Mitt. Trans. Linn. Soc. 1891: 191. 1891.

Plants dark-green to brown or nearly black when dry, loosely caespitose or gregarious; stems simple or rarely forked, 2-8 cm. long, slender but rather stiff, sometimes long-naked below, scaly below the leaves, loosely foliate above; rhizoids from basal part of stem; leaves incurved-crispate when dry, erect-spreading when moist, linear-lanceolate, or when dry almost tubular, concave, somewhat sheath-like at base, up to 5 mm. long; apex acuminate; *margin densely and sharply serrate*, plane when wet, not bordered with long cells, in most parts 2 cells thick, entire from widest part down, *ciliate where basal part narrows upward*; these cilia 3-5 on each side, composed of a single row of elongate cells; teeth composed of several to a dozen cells, coarse; lamina not undulate, without dorsal teeth, in most of its area 2 cells thick, often 1 cell thick toward margin, unistratose regions considerably scattered; *costa* percurrent, rather wide, *smooth on back*, lamellose on upper side; leaf cells at $\frac{3}{4}$ up nearly roundish-hexagonal, obscure, thick walled, about 8 μ ; basal leaf cells rectangular, thin walled, about 4-6 times as long as wide; *lamellae 5-8*, coarsely serrate, 5-8 cells high. Dioicous; male inflorescence saucer-shaped; rejuvenating through the center; calyptra glabrous, cucullate, small, shortly acuminate, covering only the lid; seta solitary, short, thick, 8-12 mm. long, undulate, reddish; capsule erect, regular, cylindrical-ovate, short; urn when empty enlarged at mouth and turbinate; neck hardly differentiated, with stomata; stomata large, with 2 guard cells; epidermis of urn smooth; peristome none; lid long-rostrate from a conic base; spores oval to somewhat angular, 12-16 μ . Type locality, Alaska (A. Kellogg).

ILLUSTRATIONS:—Engler & Prantl. Nat. Pfl.-Fam. (Ed. 2) 11: f. 779 L-R; Proc. Wash. Acad. Sci. 4: pl. 21, f. 2, a-l, also 12: 291. f. 10; Jour. Bot. 39: 341. f. 14-15; Pl. 57A.

EXSICCATI:—Holz. Musci Acro. Bor. Am. 372, 374; U. S. Soils Kelp Exped. Alaska 944 from Egg Harbor and 983 from Port Malmsbury, also 1100 from Swanson, British Columbia.

Examined:—Alaska: Wrangell (Engstrom) 1905; Yes Bay (Thomas Howell) 1895.

On soil in rather damp situations. Alaska; British Columbia; Kamchatka; Japan.

2. LYELLIA ASPERA (Hag. & Jens.) n. comb.

Philocrya aspera Hag. & Jens. Medd. om Groenland 15: 388-391. f. 1-9, 1897.

Plants gregarious, brownish, dull in luster; stems simple, 3.5-4 cm. long, chestnut brown, the lower third scaly or bare, rather suddenly leafy above, about 550 μ thick above; rhizoids on lower part of stem, comparatively few; leaves spreading from a sheathing base when damp, imbricate and crispate at tip when dry, about 8 mm. long, lanceolate from a sheathing base; sheath yellowish, not completely covering the stem, 1.9-2 mm. long, about 1.6 mm. wide, mostly 1 cell thick; costa narrow, 400 μ wide at base, percurrent or excurrent with a few rows of teeth on back near apex; lamina mostly of 1 layer of cells in the marginal region; apex blunt; margin somewhat erect, *entire below, gradually toothed upward, the teeth in pairs near the tip*; ventral layer of leaf cells higher than wide in cross section of leaf, turgid-mamillate, moderately thick walled; dorsal layer of leaf cells isodiametric, about 7 μ , with thicker outer walls; *lamellae 24-33*, 5-15 cells high, 1 cell or here and there 2 cells thick, their marginal cells like the others or somewhat higher and scarcely

thicker walled; their margins entire or crenulate. Reproduction unknown. Type locality, at about 1000 meters, Scoresby Sound, Greenland (N. Hartz) May 12, 1892. (About lat. 71° N., long. 60° W.) Known only from the type collection.

ILLUSTRATIONS:—Hag. & Jens. *l. c.*; *Pl.* 57B.

We have not seen the material; but the gametophyte is fairly well figured, and the distinctions are of specific rather than generic importance.

4. POLYTRICHADELPHUS Mitt. Jour. Linn. Soc. London 8: 49. 1865.

Plants vigorous, stiff, firm, forming loose sods, green to bluish-green, becoming reddish-brown when old; stem with a polytrichoid strand, from a subterranean rhizome, densely leafy, simple to rather fasciculately branched; leaves grading into bracts below on the stem; the larger leaves erect to spreading when moist, more or less canaliculate and appressed when dry, lanceolate from a sheathing base, with lamellae on the ventral side; margin serrate in upper part; costa with none to few small teeth on back near tip, excurrent as a red point; lamellae numerous, straight; their marginal cells usually larger than the others, somewhat ovate; cells of the median region of the sheath without chlorophyll, rectangular to linear; cells of the limb squarish to rectangular, thick walled. Dioicous; male inflorescence somewhat cup-shaped, rejuvenating from the center; *calyptra* cucullate, *from smooth to somewhat hairy; the hairs not very long, scattered or more abundant near the tip; setae 1-2 from a tip, mediumly to quite long, stiff; capsule inclined, horizontal when old, oblong or ovate, 2 or 4 angled, with numerous stomata, the hypophysis not clearly constricted from the urn; epidermal cells of the capsule without papillae; sporogenous tissue with filamentous tissue both outwardly and inwardly; lid more or less beaked from a conic base; teeth 64.*

1. POLYTRICHADELPHUS LYALLII Mitt. Jour. Linn. Soc. London 8: 49. *pl.* 8. 1865.

Oligotrichum Lyallii Lindb. Not. pro Fauna Fl. Fenn. 6: 102. 1868.

Polytrichum angustidens Lindb. Bot. Centralb. 84: 338. *pl.* 4. f. 10 a-i. 1900.

Plants in loose tufts or sods, coarse, rigid, small to large; stems 6-50 mm. long, simple or the larger commonly fastigiately branched below, scaly at base, rhizoidous only at base; bracts or scales of stem with sheathing base, about 4 mm. or less long, 2 mm. or less wide, the sheathing base constituting almost all of the limb; leaves lanceolate from a sheathing base, spreading when moist, erect when dry; their sheaths oblong, erect, about 1.8 mm. or less long, shining when dry; the limb up to 10 mm. long; apex gradually narrowed, acute; margin of the limb plane below, upward gradually erect, near the tip erect or sometimes slightly incurved, serrate, the teeth mostly spinose; costa excurrent as an awn, occupying only the central part of the sheath and smooth or slightly denticulate on back near the tip; awn reddish, short, dentate; in cross section of the costa the dorsal bundle of stereids thick and continuous, the ventral ones interrupted and not well developed, the dorsal cells somewhat larger and incrassate on their surface side; lamellae about 46, straight, of one layer of cells, 4-6 cells high, commonly 70-100 μ high, entire; their marginal cells a little larger than the others, broadly oblong, *the outer wall crescentically thickened and roughened by longitudinally elongate shallow pits*; median cells of the leaf sheath 14-18 μ wide, 40-100 μ long; cells of unistratose leaf margin at $\frac{3}{4}$ up isodiametric or some slightly longer than wide, somewhat thick-walled, 12-15 μ in longest diameter. Dioicous; male plants smaller, the antheridia at the tip; inner perichaetial leaves with longer sheath and shorter limb than the foliage leaves; *calyptra* cucullate, widely split to near the tip, covering but little of the capsule, fugaceous, *with from few hairs to quite hairy but not densely so*; its hairs erect and descending, irregularly branched or unbranched, not papillose, appressed or at maturity loosely spreading; seta solitary, terminal, elongate, 4-6 cm. long and about 0.5 mm. thick, flexuose, yellowish to brownish or reddish when old; capsule slightly inclined at time when *calyptra* falls, nearly terete but with 4 longitudinal ridges unequally distributed in the circumference; mature capsules much inclined to nearly horizontal; urn about 2.5 times as long as wide, and about 5.7 mm. long and 2.3 mm. wide below, contracted just below the mouth to about 1.5 mm., ventricose, 2-ridged on the upper side with the area between the ridges sunken, less distinctly 2-ridged on the lower side with the area between the ridges sunken toward the mouth and swollen toward the base; base irregularly rounded; epidermal cells of capsule hexagonal, with a small surface thin spot; hypophysis constricted from the capsule, distinct, rugose, short, with stomata; spore tissue with filamentous tissue exterior to it; teeth 64, narrow, about 7 cells wide at base, pale, acuminate, papillose, about 35 μ wide and 200 μ long, the basal membrane about 100 μ high; lid conic, rostrate,

oblique, about 2.2 mm. long including the beak; beak subulate, curved; spores 8.8–12 μ , smooth. Type locality, in swampy places on the east side of the Cascade Mountains, British Columbia, at an elevation of 7000 feet, July, 1860 (Lyll). Probably it was very close to the northern boundary of the U. S. since he was a member of the party surveying this.

ILLUSTRATIONS:—Jour. Linn. Soc. London 8: *pl.* 8; Bryol. 35: 37. *pl.* 4; Sull. Icones Musc. Suppl. *pl.* 40; Bot. Centralb. 84: 338. *pl.* 4. *f.* 10a–10i; Proc. Wash. Acad. Sci. 12: 293. *f.* 11; *Pl.* 58A.

EXSICCATI:—Baker, Pls. Nevada 1492, Pls. Colorado 122 (as *Polytrichum alpinum* var., determined by N. C. Kindberg); S. L. Clarke, Mosses Colorado 33 and 34 (both as *Polytrichum gracile*); Frye, Bryo. Olympic Mts. 469, 483, 564, 573, 624; Holz. Musci Acro. Bor. Am. 225 (as *Polytrichum gracile*), 375, 445 (as *Polytrichum angustidens*); Leiberg, W. Am. Mosses 73 (as *Oligotrichum Lyallii*); Porter, Bryo. Central Rocky Mts. 2082, Wyoming Mosses 625; Sandberg, Pls. N. Idaho 1121 (as *Polytrichum angustidens*); U. Wyo., Pls. Colorado 1751 (as *Polytrichum gracile*).

On various substrata, but mostly on damp soil at 3000–7000 feet altitude. Montana, Idaho and British Columbia, southward to California, Utah, Colorado and Arizona (Wootton).

As stated by Schenk & Frye, Bryologist 35: 33–38, *pl.* 4, 1932, this has a much more hairy calyptra than Sull. Icones Musc. Suppl. 56, *pl.* 40, 1874, would lead one to suppose. The characteristic brownish hairs of *Polytrichum* are present but not so abundant as in the other species of *Polytrichum*. The calyptra is smaller and falls off easily. It is therefore rarely present in packets of material with good capsules. In herbaria one finds it more often mistaken for *Polytrichum gracile* than any other moss. In the field, I believe most bryologists would call it a *Polytrichum*, even with the mature calyptra present on the then terete green capsule. The marginal cells of the lamellae are, however, more nearly like those of *Pogonatum alpinum*, although very indistinctly papillose to quite smooth.

5. POGONATUM Beauv. Prodr. 84. 1805.

Polytrichum Hedw. Sp. Musc. Frond. 88. 1801, in part.

Polytrichum section *Catharinella* C. Muell. Syn. Musc. Frond. 1: 213. 1849.

Catharinella Kindb. Rev. Bryol. 21: 35. 1894.

Plants in rather loose sods, dull-green becoming brownish with age, stiff; stems with central strand composed of two kinds of cells, stiff, scaly below, leafy above; leaves grading into the basal scales; larger leaves erect to spreading when moist, crispate or curved when dry, sometimes lanceolate to almost linear from a sheathing base, the sheath 1 cell thick except for the costa; margin of the limb entire to sharply and coarsely toothed, the unistratose portion 2–8 cells wide; costa indefinitely wide in the limb, percurrent or excurrent, usually toothed on back near tip, with lamellae on upper side except in some tropical species. Dioicous; male inflorescence cup-shaped to bud-like, commonly innovating through the tip; *calyptra* densely hairy so that its body is hidden, cucullate, the hairs not papillose; seta elongate; *capsule* terete, sometimes striate, with or without stomata, *hypophysis* from slightly constricted to none; epidermal cells of the urn often papillose to mammillate; teeth of the peristome 32 or these in various stages of doubling, of whole thick-walled cells; lid conic or depressed-conic, rostrate.

KEY.

- A. Leaves thin, quite crispate when dry, coarsely toothed; lamellae 20–40 3. *contortum*.
- AA. Leaves thick, stiff, little or not crispate when dry.
 - B. Lamellae 10–15; protoma persistent.
 - C. Leaves toothed 1. *pensilvanicum*.
 - CC. Leaves entire 1a. var. *Torreyanum*.
 - ✓ BB. Lamellae 20–70.
 - D. Leaves entire; marginal cells of the lamellae usually like the others, their walls not to little thicker; protonema persistent 2. *brachyphyllum*.
 - DD. Leaves toothed; marginal cells of the lamellae usually unlike the others, their walls thicker.
 - E. Teeth of the peristome 32; capsule without stomata, papillose.
 - F. End cells of the lamellae flat-topped in cross section, the cell-hollow transversely rectangular 5. *capillare*.
 - FF. End cells of the lamellae rounded in cross section, the cell-hollow vertically elliptical 4. *urnigerum*.

- EE. Teeth of the peristome 40-64; capsule with stomata, not papillose; in cross section the hollow of the end cells of the lamellae pear-shaped. (*P. alpinum* and varieties).
- G. Teeth of the leaves coarse.
- 1H. Leaves 4-8 mm. long; urn of capsule 1.8-4 mm. long, 2-3.5 times as long as thick; stems simple or with few branches. 6d. var. *brevifolium*.
- 2H. Leaves 7-8 mm. long; urn of capsule 4-5 mm. long, 3-5 times as long as thick; stems simple or with few branches. 6b. var. *arcticum*.
- 3H. Leaves 9-11 mm. long; urn of capsule 4-5 mm. long, 2-3 times as long as thick; stems much branched. 6. *alpinum* (typical).
- 4H. Leaves 12-14 mm. long; urn of capsule 5-6 mm. long, 3-4 times as long as thick; stems rarely branched. 6a. var. *Macounii*.
- GG. Teeth of the leaves very low or almost none. 6c. var. *septentrionale*.

I. *POGONATUM PENSILVANICUM* (Hedw.) Paris, Index Bryol. (Ed. 1) 985. 1897.

Polytrichum tenue Menz. Trans. Linn. Soc. 4: 68. 1798.

Polytrichum pensilvanicum Hedw. Sp. Musc. Frond. 96. pl. 21. f. 1-6. 1801.

Pogonatum brevicaulis Beauv. Prodr. 84. 1805.

Pogonatum tenue Rau & Hervey, Cat. N. Am. Musci. 30. 1880. Taunton, N. J. Also E. G. Brit., Observer 5: 120. 1894, and Mem. Torr. Club 4: 172. 1894.

Plants gregarious, forming thin sods, greenish to brown; stems short, usually 1-2-8 mm. long, unbranched, usually with few normal leaves between basal bracts and perichaetial leaves; rhizoidous only at base; leaves ascending when moist, erect when dry, lanceolate-subulate from a sheath-like base, the lower grading to ovate, 3-4 mm. long, the limb about 280 μ wide; sheath-like base large, distinct, about half the leaf length; apex long-acuminate, serrulate; margin serrate in the upper half, plane to erect; some of the teeth spinose; costa percurrent, smooth on back or somewhat toothed; lamellae 10-15, 4-6 cells high, crenulate toward leaf tip; their marginal cells smooth, differing little from the others, some longer and projecting somewhat above the others; cells of median region of leaf sheath rectangular, 50-115 μ long, 10-18 μ wide; cells of leaf at $\frac{3}{4}$ up thick walled, roundish or squarish to oval or rectangular, 10-20 μ in longest diameter. Dioicous; male plants intermingled with the female ones, shorter; male bracts erect-squarrose, imbricate, broadly obcordate; costa of male bract thick, excurrent into an inflated mucronate point; perichaetial leaves longer than the foliage leaves, up to 6 mm. long, the limb arista-like; calyptra extending well below the capsule, light yellow, very hairy; seta 1-2.5 cm. long, solitary, slender, smooth, yellowish to reddish; capsule erect or slightly inclined, terete, symmetric, yellowish to reddish; urn cylindric, about 4 mm. long and 800 μ wide, very little or not constricted below mouth, minutely mamillate with bulging cells; hypophysis separated by a slight constriction; lid about $\frac{1}{6}$ - $\frac{1}{5}$ as long as the urn, shortly conic; beak 1-3 times as long as the body of the lid, slightly curved; epidermal cells of the capsule roundish to oval, mostly 1-3 times as long as wide, thick walled, without a central thin spot; stomata none; spore tissue not ridged on outside, with loosely filamentous tissue only exterior to it; basal membrane about 50 μ high; teeth 32, about equal, about 200 μ long and 50-70 μ wide; spores 8-12 μ , smooth, yellowish brown. Type locality, Near Lancaster, Pennsylvania.

ILLUSTRATIONS:—Hedw. Sp. Musc. Frond. pl. 21; Jennings Man. Mosses W. Pennsylvania pl. 28; Sull. Icones Musc. pl. 47; Engler & Prantl Nat. Pfl.-Fam. (Ed. 2) 11: f. 782, A-G; Schwaegr. Suppl. 2 (2): pl. 156 in part; Grout, Mosses W. H-lens, f. 11; Pl. 58B.

EXSICCATI:—Aust. Musci Appal. 232, 233; E. G. Britton, N. Am. Mosses 489; Grout, N. Am. Musci Perf. 2 (with some sterile *Atrichum angustatum* intermingled), 123 Hand-lens Mosses 12; Holz., Musci Acro. Bor. Am. 123; Macoun, Can. Musci 377 (as *Pogonatum capillare*) 575; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 210; Drumm. Musc. Am. 70.

On moist clay banks. Newfoundland to Ontario and southward to Louisiana, Alabama and Georgia; S. America.

We use the original spelling by Hedwig, and followed by Bridel in Bryol. Univ. 2: 114, 743, 1827. C. Mueller in Syn. Musc. Frond. 1: 205, 1849, uses *pensilvanicum*, which is probably due to the somewhat interchangeable letters *i* and *y* in the German language. The earliest use of the spelling *pennsylvanicum* of which we are aware was by Sullivant in Icones Muscorum 75, 1864.

1a. Var. *TORREYANUM* (Brid.) Paris, Index Bryol. (Ed. 1) 985. 1897.

Pogonatum brevicaulis var. *Torreyanum* Brid. Bryol. Univ. 2: 115. 1827.

Polytrichum pensilvanicum var. *Torreyanum* C. Muell. Syn. Musc. Frond. 1: 205. 1849.

Plants more slender; leaves pale-green, somewhat hyaline, long subulate, apex incurved, *margin entire*; seta shorter, slightly reddish. Type locality, Massachusetts (Torrey).

On clay bank. Known only from the original collection.

We have seen no specimens of this, but there are no characteristics unless it be the entire apex which would constitute a varietal separation. The lower bract-like leaves of *P. pensilvanicum* are, however, entire and often also some of the leaves. We consider this probably the extreme form in reduction of marginal teeth.

2. *POGONATUM BRACHYPHYLLUM* (Rich.) Beauv. Prodr. 84. 1805.

Polytrichum brachyphyllum Rich., Michx. Fl. Am. Bor. 2: 225. 1803.

Pogonatum vaginans Brid. Sp. Musc. 1: 68. 1806.

Plants gregarious, forming rather dense sods, olive-green to dark-brown; stems 2-3 cm. long, simple, rigid; rhizoidous only at base; leaves 2-3 times as long as the stem, spreading when moist, erect or the tips incurved when dry, broadly lanceolate from a wide and somewhat sheathing base, 1-3 mm. long; apex bluntly acute; *margin entire*, plane; costa percurrent, smooth on back; *lamellae* 25-35, entire or very finely sinuate by bulging cells, 7-10 cells high, in lateral view all the cells rather thick walled; in cross section the *marginal cells* roundish to oval, *smooth, about the same as the others*, their wall about the same thickness as the others or slightly thicker and somewhat brownish; cells of the leaf base rectangular to hexagonal, in the middle part of the sheath 3-4 times as long as wide, 40-85 μ long, 10-17 μ wide, rather thin walled; cells at $\frac{3}{4}$ up nearly isodiametric, thick walled, rounded to oval, 9-17 μ in longest diameter. Dioicous; male plants smaller; calyptra reaching about $\frac{2}{3}$ down the capsule, dirty brown; seta solitary, 1.5-2 cm. long, solid, reddish, twisted to the right; capsule terete but slightly gibbous, ovate, slightly rough from the round bulging of the epidermal cells, yellowish brown; urn obscurely plicate when dry through the caving in of its sides; gradually narrowed to the seta; lid convex-conical, obtusely apiculate, about $\frac{2}{3}$ the length of the urn; teeth 32, equal, about 300 μ long, about 4 times as long as wide; basal membrane about 40 μ high; spore tissue not ridged, without filamentous tissue either interior or exterior; epidermal cells of capsule thick walled, 1-3 times as long as wide about middle of capsule; stomata wanting; spores 20-22 μ , smooth. Type locality, South Carolina.

ILLUSTRATIONS:—Schwaegr. Suppl. 2^o: *pl.* 156; Sull. Icones Musc. *pl.* 48; Mosses W. H-lens *f.* 11; *Pl.* 58C.

EXSICCATI:—Aust. Musci Appal. 234; Grout, N. Am. Musci Perf. 262; Holz. Musci Acro. Bor. Am. 149 (mixed with *Atrichum angustatum*); Rapp, Florida Mosses 55.

On clayey banks. New Jersey to Pennsylvania and southward to Texas, Louisiana, Mississippi, Alabama and Florida.

Sullivant, Icones Musc. *pl.* 48, shows the marginal cells of the lamellae with the outer wall thicker. Brotherus, in Engler & Prantl's Nat. Pfl.-Fam. (Ed. 2) 11: 504, 1925, places the species in a section with unthickened marginal cells. Our observations would corroborate Brotherus.

3. *POGONATUM CONTORTUM* (Schwaegr.) Sull. Icones Musc. Suppl. 58. *pl.* 42. 1874.

Polytrichum contortum Schwaegr. Suppl. 1 (2): 325. *pl.* 96. 1816.

Pogonatum laterale Brid. Bryol. Univ. 2: 112. 1827.

Pogonatum atrovirens Mitt. Jour. Linn. Soc. London 8: 49. 1865.

Pogonatum dentatum of Lesq. Mem. Cal. Acad. Sci. 1: 27. 1868. Not *Polytrichum dentatum* Schwaegr. Suppl. 1 (2): 321. 1816.

Pogonatum erythrodontium Kindb., Macoun, Cat. Can. Pls. 6: 150. 1892.

Catharinella contorta Kindb. Rev. Bryol. 21: 35. 1894.

Catharinella atrovirens Kindb. Rev. Bryol. 21: 35. 1894.

Catharinella erythrodontia Kindb. Rev. Bryol. 21: 36. 1894.

Plants gregarious, forming loose sods, glaucous-green to brown; stems 4-6-12 cm. long, simple or branching near tip, rhizoidous at base only; leaves not crowded, spreading when moist, rather erect *when dry but very markedly contorted*, gradually grading into the scales on lower part of stem, linear-lanceolate, wider near base but hardly sheathing, the larger 5-7 mm. long, the limb 0.8-1.2 mm. wide; apex acute;

margin sharply and coarsely serrate to base, plane, 2 cells thick for a width of 1-3 cells; costa excurrent, slightly toothed on back above; lamellae 20-40, entire, 3-5 cells high; in cross section the marginal cells like the others or slightly larger, oval, not thicker walled, smooth; cells of median region of leaf sheath squarish to rectangular, 15-22 μ wide, 17-35 μ long; cells at $\frac{3}{4}$ up roundish-angular, isodiametric or nearly so, 15-20 μ in longest diameter, rather thin walled. Dioicous; male plants smaller, innovating from the middle of the tip; perichaetial leaves similar to the foliage leaves; calyptra completely covering the capsule, its hairs light-yellow and smooth; seta 3-4 cm. long, thin, somewhat twisted to the right, reddish when young, passing through brown to black with age; capsule erect to inclined, terete, grayish-green to blackish, distinctly mamillate by the swollen cells of the epidermis; urn ovate to cylindric, 3-4 mm. long, markedly contracted under the mouth, 500-600 μ thick about the middle; not constricted near base to cut off a hypophysis; lid dome-shaped, rostrate, $\frac{1}{2}$ - $\frac{2}{3}$ as long as the urn, beak straight or nearly so; epidermal cells of capsule rectangular, 1.5-2 times as long as wide, with all the walls very thick; stomata wanting; spore tissue decidedly ridged on the outside, without loosely filamentous tissue either interior or exterior to it; basal membrane rather high, $\frac{1}{2}$ - $\frac{1}{2}$ as high as the teeth are long, about 70 μ high; teeth 32, rather unequal, with some tendency toward double teeth, 250-300 μ long, about 85 μ wide, rounded at tip; spores 11-13 μ , smooth, yellowish. Type locality, West coast of North America (Menzies).

ILLUSTRATIONS:—Schwaegr. Suppl. 12: pl. 96 in part; Proc. Wash. Acad. Sci. 12: 296. f. 12; Sull. Icones Musc. Suppl. pl. 42; Engler & Prantl Nat. Pfl.-Fam. (Ed. 2) 11: 507. f. 784; Pl. 594.

EXSICCATI:—Frye, Bryo. Olympic Mts. 525; Henderson, Pls. N. W. U. S. 16998; Holz. Musci Acro. Bor. Am. 175; Howell, N. Am. Mosses 1831; Macoun, Can. Musci 580; U. S. Soils Kelp Exped. Alaska 242, 393, 699, 830, 866, 939, 963, 987, 1104, 1105, 1213.

On clayey soil in humid situations. Alaska to California; Asia.

4. *POGONATUM URNIGERUM* (Hedw.) Beauv. Prodr. 84. 1805.

Polytrichum urnigerum Hedw. Sp. Musc. Frond. 100. pl. 22. f. 5-7. 1801.

Polytrichum fasciculatum Michx. Fl. Bor. Am. 2: 294. 1803.

Pogonatum fasciculatum Beauv. Prodr. 84. 1805.

Pogonatum pulverulentum Beauv. Prodr. 84. 1805.

Polytrichum pulverulentum Beauv. Prodr. 84. 1805.

Pogonatum urnigerum var. *fasciculatum* Brid. Bryol. Univ. 2: 126. 1827.

Pogonatum urnigerum var. *pulverulentum* Brid. Bryol. Univ. 2: 126. 1827.

Plant gregarious, forming rather loose sods, glaucous-green to brownish; stem 2-4-10 cm. long, unbranched or commonly branched well up, several-angled, rhizoidous at base only; leaves abruptly grading into scales below; the longer leaves, spreading when moist, erect or incurved when dry, lanceolate from a sheathing base, up to 7 mm. long, the limb 450-800 μ wide; apex acute or acuminate; margin serrate nearly or quite to the sheath, plane; costa excurrent, sharply toothed on back near tip; lamellae 40-50, entire or nearly so except for papillae, 4-6 cells high; in cross section their marginal cells distinctly large, round or oval and higher than wide, thick walled, distinctly papillose; cells of sheath rectangular, hyaline; in the median region 10-15 μ wide, 25-37 μ long; cells at $\frac{3}{4}$ up squarish or hexagonal to rectangular, from shorter to longer than wide, somewhat thick walled, 17-25 μ in longest diameter. Dioicous; male plants among the female about the same size; male bracts ovate, composed of sheath with a short point of limb; perichaetial leaves with longer sheath and shorter and narrower blade; calyptra extending below the capsule, yellowish brown, the hair smooth; seta 1-3-5 cm. long, twisted to the right above, reddish at base; capsule erect to slightly inclined, terete, yellowish-brown to reddish-brown; urn ovate to cylindric, about 500 μ thick and 3 mm. long, wide mouthed, distinctly papillose or mamillate, without a hypophysis; lid 300-1000 μ long, roundish-conic, the beak straight or slightly curved; epidermal cells of the urn roundish to oval, rather thick walled, without a thin spot; stomata wanting; spore tissue with 4 longitudinal ridges on inner side, with loosely filamentous tissue both interior and exterior to it; basal membrane 100-120 μ high; teeth 32, about 180 μ long, reddish; spores 12-14 μ , smooth. Type locality, European.

ILLUSTRATIONS:—Hedw. Sp. Musc. Frond. pl. 22. f. 5-7; Broth. Laubm. Fennoskandias f. 117E-H; Braithw. Brit. Moss Fl. 1: pl. 6; B. S. G. Bryol. Eur. pl. 417; Proc. Wash. Acad. Sci. 12: 300. f. 14; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) pl. 5 F; Pl. 59B.

EXSICCATI:—Aust. Musci Appal. Suppl. 522; Foster 524, 1856; Grout, N. Am. Musci Perf. 31a, 31b, Hand-lens Mosses 13; Holz. Musci Acro. Bor. Am. 100; Macoun, Can. Musci 581; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 213; U. S. Soils Kelp Exped. Alaska 1036, 1237, 1241.

On soil, and on rocks with a covering of soil. Greenland to Alaska, southward to Oregon, Colorado, New York and New Hampshire; Europe; Asia; Africa; West Indies.

5. *POGONATUM CAPILLARE* (Rich.) Brid. Bryol. Univ. 2: 127. 1827.

- Polytrichum capillare* Rich., Michx. Fl. Bor. Am. 2: 294. 1803.
Pogonatum yuccaefolium Beauv. Prodr. 85. 1805.
Polytrichum dentatum Brid. Sp. Musc. 1: 66. 1806.
Polytrichum capillare var. *minus* Wahlenb. Fl. Lapp. 348 in part. 1812.
Polytrichum urnigerum var. *capillare* Wahlenb. Fl. Suec. (Ed. 1) 2: 739. 1826.
Pogonatum dentatum Brid. Bryol. Univ. 2: 122. 1827.
Pogonatum intertextum LaPyl., Brid. Bryol. Univ. 2: 742. 1827.
Pogonatum longidens Angstr. Thed. Nya. Bot. Not. 1852.
Polytrichum capillare var. *oxycalyx* Lindb. Bot. Not. 137. 1867.
Polytrichum capillare var. *dentatum* Lindb. Acta Soc. Sci. Fenn. 10: 266. 1872.
Polytrichum Wahlenbergii Kindb. Rev. Bryol. 21: 37. 1894.
Pogonatum dentatum var. *minus* Hag. Danske Kgl. N. Videns. Sællsk. Skrift. 1913 (1): 32. 1914.

Plant gregarious, forming loose sods, glaucous-green to reddish-brown; stem 2-4 cm. long, commonly unbranched but sometimes branched, 3-angled below, 5-angled in leafy part, rhizoidous only at base; leaves spreading when moist, appressed when dry, not or little twisted when dry, linear-lanceolate from a sheath-like base, up to 8 mm. long and about 500 μ wide; apex acute or acuminate; margin sharply serrate nearly to sheath; costa excurrent as a brownish tooth, smooth on back or with 1-4 low teeth near tip; lamellae 25-55, entire⁸, straight, 6-8 cells high; in cross section their marginal and often also the sub-marginal cells wider than the others, squarish to transversely rectangular; their outer wall flattish, thick, papillose, colorless to brownish; cells of the median region of the sheath 9-14 μ wide, 17-26 μ long; cells of the unistratose leaf margin at $\frac{3}{4}$ up wider than long to squarish or somewhat rounded, 10-17 μ in longer diameter, with rather thick walls. Dioicous; male plants among the female ones, somewhat smaller; most of the male bracts toothed; perichaetial leaves with long sheath, entire to serrate, the limb almost limited to the costa; calyptra hardly covering the base of the capsule, the hairs smooth; seta 1.5-3 cm. long, twisted to the right above, with cylindrical hollow, yellowish-red; capsule slightly inclined, terete, yellowish-brown; urn oval to cylindrical, about 1.5 mm. thick and 3 mm. long, wide-mouthed when empty, the mouth red; neck slightly concave to not constricted at all; lid dome-shaped, about $\frac{2}{3}$ as long as the urn, yellow, the beak straight or nearly so, averaging about $\frac{2}{3}$ as long as the lid is wide; epidermal cells of capsule roundish to oval, thick walled, slightly mammillate, without a central thin spot on each cell; stomata wanting; spore tissue not or indistinctly ridged on outer side, without loosely filamentous tissue either interior or exterior to it; basal membrane hardly projecting; teeth 32, about equal, 275-350 μ long, 60-80 μ wide, finely punctate; spores 13-21 μ , very nearly smooth, light yellow. Type locality, North Carolina.

ILLUSTRATIONS:—Trans. Linn. Soc. 4: pl. 7. f. 4; Schwaegr. Suppl. 2: pl. 155; Sull. Icones Musc. pl. 49, also Suppl. pl. 41; Proc. Wash. Acad. Sci. 12: 298. f. 13; Broth. Laubm. Fennoskandias f. 117, J-L; Engler & Prantl, Nat. Pfl.-Fam. (Ed. 2) 11: f. 788; Pl. 59C.

EXSICCATI:—Aust. Musci Appal. 523; Drumm., Musci Bor. Am. (Ed. 1) 284 as *Polytrichum urnigerum*; Frye, Bryo. Olympic Mts. 13, 611; Grout, Hand-lens Mosses 11; Howell, N. Am. Mosses 1832; Holz. Musci Acro. Bor. Am. 299; Macoun, Can. Musci 219 as *Pogonatum urnigerum*; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 212; Taylor, Pls. B. C. 149; U. S. Kelp Exped. Alaska 15, 511, 966, 1214, 1240.

On bare or sandy soil, often on the banks of streams at high altitudes and latitudes. Greenland to Newfoundland and New York, southward to North Carolina; Rocky Mountains; Alaska to Oregon; Europe; Asia.

6. *POGONATUM ALPINUM* (Hedw.) Roehl., Ann. Wett. Gesell. 3: 226. 1812.

- Polytrichum alpinum* Hedw. Sp. Musc. Frond. 92. pl. 19. f. 2 and b. 1801.
Polytrichum ferrugineum Brid. Sp. Musc. 1: 61. 1806.
Polytrichum ambiguum Brid. Sp. Musc. 1: 62. 1806.
Polytrichum furcatum Hornsch., Nees Hor. Phys. Berol. 76. 1820.
Pogonatum furcatum Brid. Bryol. Univ. 2: 133. 1827.
Polytrichum alpinum var. *furcatum* C. Muell. Syn. Musc. Frond. 1: 211. 1849.

Plant gregarious, forming loose sods, dull-green to reddish-brown; stem 2-8-20 cm. long, simple or usually branched, irregularly angular in the leafy part; leaves erect to spreading when dry, spreading when moist, linear-lanceolate from a long sheathing base, 6-8-10 mm. long, the lamina about 500 μ wide; apex acuminate, red, serrate; margin sharply serrate to the base or nearly so, erect; costa excurrent, toothed on back near apex; lamellae 33-48, entire except for papillosity, 5-8 cells high; in cross section the marginal cells

ovate-conic to pyriform, larger than the others, thick walled except on the inner side, papillose; cells of the central region of the sheath long-rectangular, about $9 \times 45\text{--}85 \mu$, those toward the margin narrower; cells of the limb at about $\frac{3}{4}$ up the leaf squarish to rectangular, sometimes a little wider than long, $9\text{--}16 \mu$ in longest diameter; cuticle striate. Dioicous; male plants shorter and more slender; male bracts obovate, pointed; perichaetial leaves much like the others; calyptra slightly shorter than the capsule, reddish brown; seta 3–5 cm. long, twisted to the right, with central hollow, reddish-yellow; capsule erect or usually inclined, sometimes slightly curved, terete, smooth or nearly so, yellowish-green to light-brown; urn narrowly ovate; to cylindric, 2–2.5 mm. thick, 2.25–4 mm. long; neck slightly contracted; lid about half as long as the urn, dome-shaped, with slightly curved beak; annulus of one row of rather small cells; epidermal cells of the capsule mostly angular, rather thick walled, isodiametric or nearly so, without a thin central region, faintly and irregularly striate; stomata restricted to the hypophysis, many, large; spore tissue with 4 longitudinal ridges on inner side, terete on outer side, with loosely filamentous tissue interior and exterior to it; peristome $210\text{--}230 \mu$ high; basal membrane $30\text{--}50 \mu$ high; teeth 40–60, sometimes irregular, commonly unequal, about 180μ long, rounded at tip; spores $18\text{--}21 \mu$, finely punctate, ochroleucous. Type locality, European.

ILLUSTRATIONS:—Hedw. Sp. Musc. Frond. pl. 19. f. 2 and b; B. S. G. Bryol. Eur. pl. 418; Proc. Wash. Acad. Sci. 12: 302. f. 15, also f. 16 in part; Braithw. Brit. Moss Fl. 1: pl. 6D; Pl. 60.

EXSICCATI:—Aust. Musci Appal. 521; Grout, Hand-lens Mosses 10; Holz. Musci Acro. Bor. Am. 73, 200, 595; Macoun, Can. Musci 582; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 214; Drumm. Musc. Am. 282. On soil. Greenland to Alaska, southward to Newfoundland, New Hampshire, Vermont, New York, Ontario, Minnesota, Colorado, Idaho and Washington; Europe; Asia; Antarctica; Oceanica.

There are no sharp lines anywhere within the species *P. alpinum*. The most vigorous variation is the var. *Macounii*, with cylindrical capsule reaching at best 6 mm. long. The var. *arcticum* has rather shorter and narrower capsule, reaching at most 5 mm. long, and perhaps only half or $\frac{2}{3}$ as wide. But this variety grades into var. *Macounii* and into typical *P. alpinum*. Typical *P. alpinum* has a capsule shorter and often but not always wider at base than farther up. Often it is merely shorter than in var. *Macounii*. Var. *septentrionale* is a rather dwarfed *P. alpinum* with the leaf serrations quite weakly developed. Var. *brevifolium* is merely a more stunted plant sometimes branched and sometimes not, and the more stunted the less likely to be branched. When unbranched it is often referred to as var. *simplex*. There does not seem to be sufficient reason for a var. *simplex*, so this is herein combined with var. *brevifolium* which constitutes those having a leaf limb not over 3 times as long as the sheath, and a capsule commonly 2–3 mm. long. The shorter leaves go with the shorter capsules. There appears to be no break in the gradation from the largest to the smallest where a line of specific value may be drawn.

Hasselbo in Medd. om Groenland 43: 171, 1910, reports *Polytrichum fragile* Bryhn from the east coast of Greenland. We have neither material nor description of this. However, Brotherus in Engler & Prantl (Ed. 2) 11: 512, 1925, refers it to the *alpinum* group.

6a. Var. *MACOUNII* (Kindb.) Card. & Thér., Proc. Wash. Acad. Sci. 4: 328. 1902.

Pogonatum Macounii Kindb. Bull., Torr. Club 16: 96. 1889.

Polytrichum Macounii Kindb. Bidrag. 453, according to Paris Index Bryol. (Ed. 2) 4: 49. 1905.

Stems 5–7–14 cm. long, simple or slightly branched above; leaves narrowly lanceolate from a sheathing base, 12–14 mm. long, the limb 5–7 mm. wide. Urn of the capsule 5–6 mm. long, 1–1.5 mm. thick. Type locality, along the borders of ravines at an altitude of 4500 feet on Mt. Arrowsmith on Vancouver Island, British Columbia (John Macoun) July 13, 1887.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. 12: 305. f. 16; Pl. 60.

EXSICCATI:—Allen, Mosses Cascade Mts. 77; Holz. Musci Acro. Bor. Am. 200 b, 417; U. S. Soils Kelp Exped. Alaska 139, 394, 449, 486, 518, 775.

On soil and in rock crevices in damp situations. Alaska, British Columbia, Washington; Asia.

The var. *Macounii* is nearest the var. *arcticum*, both having long capsules. The former has thicker capsules and is a larger looser plant. There is no sharp boundary between these two varieties.

6b. Var. *ARCTICUM* (Wahlenb.) Brid. Bryol. Univ. 2: 131. 1827.

Polytrichum alpinum var. *arcticum* Wahlenb. Fl. Lapp. 346. 1812.

Pogonatum arcticum Roehl., Ann. Wett. Gesell. 3: 226. 1812.

*Pogonatum Pylaeii** Brid. Bryol. Univ. 2: 744. 1827.

Pogonatum alpinum var. *angustifolium* Lindb. Bot. Not. 130. 1867.

* This is the spelling by Bridel. Many European authors spell it *Pylaisii*.

Pogonatum alpinum var. *silvaticum* Lindb. Bot. Not. 130. 1867.

Polytrichum alpinum var. *silvaticum* Lindb. Musc. Scand. 12. 1879.

Larger leaves 7-8 mm. long; seta 2-4 cm. long; capsule cylindric, narrow, 3-5 times as long as wide, 4-5 mm. long. Type locality probably given in Trans. Linn. Soc. 4: 12, 1798, which is not available to us.

ILLUSTRATIONS:—Trans. Linn. Soc. 4: pl. 7. f. 6; Sw. Musc. Suec. pl. 8. f. 17; Proc. Wash. Acad. Sci. 12: 306. f. 17; Pl. 60.

EXSICCATI:—U. S. Soils Kelp Exped. Alaska 1239.

On soil. Greenland, Nova Scotia, Minnesota, Alaska, Washington; Europe.

6c. Var. SEPTENTRIONALE (Roehl.) Brid. Bryol. Univ. 2: 131. 1827.

Pogonatum septentrionale Roehl. Ann. Wett. Gesell. 3: 226. 1812.

Polytrichum septentrionale Brid. Mant. Musc. 4: 198. 1819.

Polytrichum alpinum var. *septentrionale* Lindb. Not. Saellsk. Fauna Fl. Fenn. 9: 131. 1867.

Pogonatum alpinum var. *microdontium* Kindb., Macoun Cat. Can. Pls. 6: 152. 1892.

Leaves almost to quite entire. Type locality, Scandinavian Peninsula.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. 12: 306. f. 17; Pl. 60.

EXSICCATI:—Macoun, Can. Musci 582a, 427, 600.

On soil. Greenland, Alaska to British Columbia and Colorado; Europe; Asia.

From the description of *Polytrichum polare* C. Muell., Bot. Leit. 17: 205, 1859, later published as *Pogonatum polare* Jaeg. Gen. et Sp. Musc. Syst. Adumbratio Fl. Musc. 1: 742, 1873-1874, it seems that probably it falls under *Pogonatum alpinum* var. *septentrionale*. However, we have not been able to see the material, and the marginal cells of the lamellae, which are crucial in determining the species, are unfortunately not described. *Pogonatum polare* is reported from Greenland.

Likewise *Pogonatum Vanhoeffeni* Kindb. Biblioth. Bot. 42: 66, 1897, seems to fall under *Pogonatum alpinum* var. *septentrionale*, although the description is quite inadequate even to show conclusively that it is a *Pogonatum* rather than a *Polytrichum*. I have been unable to borrow a specimen for examination. It was described from material gathered in Greenland by E. Vanhoeffen.

6d. Var. BREVIFOLIUM Brid. Bryol. Univ. 2: 131. 1827.

Polytrichum brevifolium R. Br. Parry's Voyage Suppl. 294. 1824.

Pogonatum campanulatum Brid. Bryol. Univ. 2: 133. 1827.

Pogonatum alpinum var. *campanulatum* B. S. G. Bryol. Eur. 21-22: 9. 1844.

Polytrichum campanulatum Hornsch., Nees Hor. Phys. Berol. 67. pl. 13. 1820.

Polytrichum alpinum var. *campanulatum* Angstr. Fr. Summ. Veg. 90. 1846.

Polytrichum alpinum var. *brevifolium* C. Muell. Syn. Musc. 1: 211. 1849.

Pogonatum alpinum var. *simplex* Schimp. Coroll. Bryol. Eur. 91. 1856.

Plants small; stems 1-4 cm.; leaves sharply serrate as in the type, short, 5-8 mm. long; limb 1-3.5 times as long as the sheath. Seta short, 1-3 cm. long; capsule smaller, 1.8-3 mm. long. Type locality, Unalaska, Alaska (Chamisso).

ILLUSTRATIONS:—Nees Hor. Phys. Berol. pl. 13; Proc. Wash. Acad. Sci. 12: 306. f. 17; Pl. 60.

On wet rocks and shady banks in mountains or far north. Greenland, Melville Island, Alaska southward to Massachusetts, Colorado and California; Iceland; Europe; Asia.

5. POLYTRICHUM Hedw. Sp. Musc. Frond. 88. 1801.

Plants in loose to dense sods, green, brown with age; stems stiff, from subterranean rhizome, with central strand of two kinds of cells, scaly below, mostly densely leafy above; leaves grading into the bracts below them; larger leaves usually erect when dry, lanceolate to linear-lanceolate from a sheathing base, the sheath one cell thick, often with little chlorophyll; margin of the limb entire to coarsely toothed, the unistratose portion 2-15 cells wide; costa of rather indefinite width, often toothed on back near tip, with many ventral lamellae, often excurrent as an awn. Dioicous; male plants among the female; male inflorescence cup-shaped to saucer-shaped, rejuvenating from the center; calyptra densely hairy so that its body is hidden, cucullate, the hairs not papillose; seta elongate, stiff; capsules solitary, 4-6-angled, with stomata at base, with hypophysis from fairly distinct to constricted from the base of the urn; teeth of the peristome 64, composed of whole thick walled cells; lid flattish to conical, usually with a beak.

KEY.

- A. Leaf margin more or less toothed.
 - B. Marginal cells of lamellae like the others in size and thickness of wall; lamellae entire.
 - C. Cells of middle of leaf sheath at $\frac{2}{3}$ distance from margin to costa 5.5-9 times as long as wide; at $\frac{3}{4}$ up the leaf the unistratose margin 2-3 cells wide; epidermal cells of the capsule with or without surface thin spot... 1. *formosum*.
 - CC. Cells of middle of leaf sheath at $\frac{2}{3}$ distance from margin to costa 1.5-4 times as long as wide; at $\frac{3}{4}$ up the leaf the unistratose margin 4-9 cells wide; epidermal cells of the capsule without surface thin spot... 2. *gracile*.
 - BB. Marginal cells of lamellae unlike the others in size or thickening of wall.
 - D. Marginal cells of lamellae flat-topped, not notched or only near leaf margins and base slightly so.
 - E. Marginal cells of lamellae thicker walled than the others; epidermal cells of the capsule without surface thin spot... 3. *ohioense*.
 - EE. Marginal cells of lamellae not thicker walled than the others; epidermal cells of the capsule with surface thin spot... 4. *Swartzii*.
 - DD. Marginal cells of lamellae notched in cross section (*P. commune* and varieties).
 - F. Leaves toothed to the sheath or nearly so.
 - G. Perichaetial leaves about like the others... 5. *commune* (typical).
 - GG. Perichaetial leaves distinctly longer and erect in a tuft about the seta... 5a. var. *perigoniale*.
 - FF. Leaves toothed to about the middle of the limb... 5b. var. *Jensenii*.
 - DDD. Marginal cells of lamellae pear-shaped... 7 b. var. *Waghornei*.
- AA. Leaf margin entire.
 - H. Marginal cells of lamellae notched in cross section... 5c. var. *yukonense*.
 - HH. Marginal cells of lamellae not notched in cross section, more or less pear-shaped.
 - I. Leaves blunt, cucullate; capsule usually 6-angled... 6. *norvegicum*.
 - II. Leaves with costa excurrent as an awn; capsule 4-angled.
 - J. Awn of the leaf reddish.
 - K. Stem with rhizoids only at base; capsule 1.5-2 times as long as thick; leaves entire... 7. *juniperinum*.
 - KK. Stem with dense mat of rhizoids even up among well developed leaves; capsule hardly longer than thick; leaves entire... 7a. var. *alpestre*.
 - KKK. Stems with rhizoids only at base; capsule unknown; leaves somewhat serrulate near tip... 7b. var. *Waghornei*.
 - JJ. Awn of the leaf hyaline or merely reddish at base.
 - L. Stems simple, short, densely leafy... 8. *piliferum*.
 - LL. Stems mostly branched, extended, laxly leafy... 8a. var. *hyperboreum*.

1. POLYTRICHUM FORMOSUM Hedw. Sp. Musc. Frond. 92. pl. 19. f. 1a. 1801.

- Polytrichum pallidisetum* Funck, Hoppe Bot. Tasch. 44. 1802.
Polytrichum attenuatum Menz., Smith Eng. Bot. pl. 1198. 1803.
Polytrichum commune var. *attenuatum* H. & T. Muscol. Brit. 26. 1818.
Polytrichum formosum var. *quadrangulare* Hartm. Skand. Fl. (Ed. 1) 404. 1820.
Polytrichum formosum var. *pallidisetum* Steud. Nom. Crypt. 352. 1824.
Polytrichum coronatum Brid. Bryol. Univ. 2: 748. 1827.
Polytrichum superbum Schultz, Syl. Fl. 152. 1828.
Polytrichum formosum var. *superbum* Fiedl. Laubm. Meckl. 97. 1844.
Atrichum anomalum Milde, Bot. Zeit. 27: 824. 1869.
Polytrichum conorhynchum Kindb., Macoun Cat. Can. Pls. 6: 154. 1892.

Plants forming thin sods, dark-green to brownish-green; stems 6-12-22 cm. long, unbranched or forked, several-angled in cross section; central strand in leafy region well defined, its cells thick walled, brownish; outward from the strand several layers of thin walled cells, the outermost portion of 2-3 layers of thick walled cells larger than those of the strand; rhizoids only at the base of the upright stems; leaves spreading when moist, erect or nearly so when dry, linear-lanceolate from a sheathing base, 5-7-12 mm. long; the limb 770-1000 μ wide; *apex acuminate into a serrate and usually red point; margin serrate nearly to sheath, plane to erect; teeth quite spinose, the unistratose portion near middle of limb usually 2-3 cells wide; costa excurrent, toothed on back above; lamellae 30-70, entire, 3-5 cells high; in cross section the marginal ones like the others or slightly larger, isodiametric or slightly wider than long, smooth, not or hardly thicker walled; cells of leaf sheath 5-10 times as long as wide, hyaline, median ones 10-15 μ wide, 55-120 μ long, cells of the unistratose border at $\frac{3}{4}$ up squarish to roundish or oval, 10-22 μ in longest diameter. Dioicous; male plants shorter, more slender; male bracts cuspidate; perichaetial leaves longer than the foliage leaves, long acuminate, the sheath about half the length, not membranous; calyptra covering the whole capsule, light reddish-brown, quite hairy; seta 4-8 cm. long, stout, flattened toward top, not twisted, yellowish-red, often light yellow above; capsule erect to horizontal, acutely 5-6-angled, rarely 4-angled, light-yellow to brownish-yellow; urn about 2.5 mm. thick and 5 mm. long; hypophysis constricted from the urn; lid broadly conic, about $\frac{1}{3}$ the length of the urn, beak straight, rim red; epidermal cells of the capsule somewhat turgid, thick-walled, with or without median thin spot on outer side, irregularly roundish or 4-6-angled, in the middle of the urn about 35 μ ; stomata numerous, in the neck region, oval, 2-celled, the opening a crack; spore tissue with filamentous tissue at least external to it; teeth 64, equal, mostly about 240 μ long and 75 μ wide, papillose; basal membrane projecting about 70 μ , orange; spores 10-14 μ , finely punctate, ochraceous. Type locality, "Bei den Vogelsteinen in der Oberlausitz," Germany (C. Ludwig).*

ILLUSTRATIONS:—Hedw. Sp. Musc. Frond. pl. 19. f. 1 and a; Proc. Wash. Acad. Sci. 12: 311. f. 19; Bryol. Eur. pl. 420; Braithw. Brit. Moss Fl. 1: pl. 7 in part; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) pl. 6F; Engler & Prantl Nat. Pfl.-Fam. (Ed. 2) 10: 34-35. f. 32-33; Pl. 61A.

EXSICCATI:—Aust. Musci Appal. 236; Grout, N. Am. Musci Perf. 220; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 215; U. S. Soils Kelp Exped. Alaska 52, 212, 264, 564, 620, 831, 1095, 1106, 1117, 1209, 1211, 1223, Yakutat Bay, Alaska (F. Funston 152) as *Polytrichum urnigerum*; Drummond, 279 as *P. pallidisetum*.

On soil and rocks. Greenland southwestward to Miquelon Isl., New Hampshire; Vermont, Connecticut, North Carolina, New York and Ontario; Alaska to Oregon; Europe; Asia; Africa.

P. formosum sometimes has a thin spot in the surface cell of the capsule and sometimes not. Possibly they do not show in rather immature capsules; naturally they are not yet present in very young ones.

2. POLYTRICHUM GRACILE Sm. Fl. Brit. 3: 1374. 1804.

*Polytrichum marginatum** Wahlenb., Web. & Mohr. Ind. Mus. Pl. Crypt. 1803.

Polytrichum attenuatum var. *aurantiacum* Turn. Musc. Hibern. 84. 1804.

Polytrichum longisetum var. *aurantiacum* Turn. Musc. Hibern. 84. 1804.

Polytrichum longisetum Brid. Sp. Musc. 1: 59. 1806.

Polytrichum aurantiacum Wahlenb. Fl. Lapp. 345. 1812.

Polytrichum formosum var. *aurantiacum* Hartm. Skand. Fl. (Ed. 1) 404. 1820.

Polytrichum commune var. *aurantiacum* Wahlenb. Fl. Suec. (Ed. 1) 2: 734. 1826.

Polytrichum formosum var. *gracile* Vent. & Bott. Enum. Crit. 30. 1884.

Catharinea Dixoni Braithw., Dixon in Jour. Bot. Brit. 23: 169. 1885.

Catharinella Dixoni Kindb. Eur. & N. Am. Bryin. 157. 1897.

Plants densely tufted, dark green; stems 3-5-10 cm. long, nearly always simple, angular; rhizoidous below the leafy portion, the rhizoids numerous, whitish, matting the stems together; leaves erect-patent when moist, applied to the stem and somewhat flexuose or curled when dry, lanceolate from a sheathing base, the longer 8-10 mm. long, the limb 600-900 μ wide; apex gradually narrowed to a sharp, acute, serrate, red arista; margin serrate to near the sheath, erect, the *unistratose portion usually 4-9 cells wide* near the middle of the limb; leaf teeth spinose; costa excurrent, smooth or with 1-2 small teeth on back; lamellae 30-45,

* Dr. J. H. Barnhart, of the New York Botanical Garden, has kindly checked the synonymy but it seems doubtful whether any description accompanied the publication of the name *Polytrichum marginatum* in Weber & Mohr, or Mohr, "Index musei plantarum cryptogamicarum." Neither he nor I have seen the work. It is considered best to leave the plant *Polytrichum gracile* until it is certain that *P. marginatum* is not a *nomen nudum*.

entire, 4-6 cells high; in cross section the *marginal cells like the others, smooth, rounded, not thicker walled*; cells of the leaf sheath rectangular; median ones 15-19 μ wide, 30-60 μ long, thus about 2-4 times as long as wide; cells of the unistratose border about $\frac{3}{4}$ up 15-18 μ , round-quadrate to transversely elliptic. Dioicous, male plants with shorter leaves; male bracts obovate, acuminate; perichaetial leaves about 12 mm. long, the sheath constituting about half the length, membranous at margin, apex longer pointed than the foliage leaves; calyptra covering half to nearly all the capsule, rusty yellow; seta 4-10 cm. long, thin flexuose; capsule erect to horizontal, obtusely and often obscurely 5-6 angled, broadly ovate, narrower at the red mouth; urn about 2.5 mm. thick and 4 mm. long, yellowish-green, brown with age; hypophysis hardly constricted from urn, but constriction more prominent with age; lid about half as long as the urn, rather long-beaked from a conic base, the beak curved; *epidermal cells of the capsule* 4-6-angled, 1-2 times as long as wide, only slightly thick walled, *without central thin spot*; stomata only at the neck, 2-celled, spore tissue with 4 or 8 longitudinal ridges, with loosely filamentous tissue both interior and exterior to it; basal membrane hardly projecting from the mouth; teeth 64 or fewer through confluence, unequal, finely papillose, about 50 μ wide and 280-320 μ long; spores 18-20 μ , finely warty, olive green. Type locality, European.

ILLUSTRATIONS:—Schwaegr. Suppl. 2: *pl.* 148; B. S. G. Bryol. Eur. *pl.* 421; Proc. Wash. Acad. Sci. 12: 310. *f.* 18; Braithw. Brit. Moss Fl. 1: *pl.* 7B; Limpr. Laubm. 2: 622. *f.* 322; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl.* 6D; *Pl.* 61B.

EXSICCATI:—Sull. & Lesq. Musci Bor. Am. (Ed. 1) 216; U. S. Soils Kelp Exped. Alaska 1106; Drummond 276, as *P. formosum*, and 280 as *P. pallidisetum* var.

On damp soil at both low and high altitudes. Greenland to Alaska, southward to Connecticut, Ohio, Florida, Minnesota, Colorado, and Oregon; Europe; Asia; New Zealand.

The separation between *P. formosum* and *P. gracile* is not distinct. The ovate form of the capsule, the shorter leaves and more blunt angles of the capsule of *P. gracile* cannot be relied upon when material from widely different regions is considered. The age of the capsule has a great deal to do with the sharpness of the angles. All the Polytrichaceae have terete capsules when young. Variations in the form of capsules and size of leaves are not concurrent. Perhaps the best character upon which to rely is the shorter cells of the sheath in *P. gracile*. With this, at least nearly always, goes the wider unistratose margin of the limb. It is desirable that someone examine a great deal of material from various regions of the earth to find just what is reliable. We are in doubt whether this is best recognized as a species or as a variety of *P. formosum*.

All material of *P. gracile* seen from Colorado proved to be *Polytrichadelphus Lyallii* except one collection by Grout near Tolland in 1914. It may therefore be wise to mention that the latter always shows the outer walls of the marginal cells of the lamellae much thickened, while the former does not. This is the easiest way to be sure between the two when the material is only vegetative. A side view of a lamella will distinguish the two at a glance.

3. POLYTRICHUM OHIOENSE Ren. & Card., Rev. Bryol. 12: 11. 1885.

Polytrichum formosum of Lesq. & James, Man. Mosses N. Am. 264. 1884. Not of Hedw. Sp. Musc.

Frond. 92. *pl.* 19, *f.* 1 and *a.* 1801.

Polytrichum decipiens Limpr. Jahrb. Schles. Gesell. Vaterl. Cult. 67: 93. 1890.

Polytrichum Smithiae Grout, Bryol. 6: 41. *pl.* 8. *f.* 1, 10-11. 1903.

Plants forming loose sods, bluish-green to reddish-brown; stems 2.5-5-8 cm. long, mostly unbranched, rarely forked, 3-angled below, 5-angled in leafy part; central strand in leafy part colorless, surrounded by a layer of large thin walled cells, the outermost 1-2 cortical layers of small yellowish stereid cells; rhizoids only near base of stem, not very abundant; leaves spreading to recurved when moist, erect-spreading to appressed when dry and somewhat contorted, rather crowded, linear-lanceolate from a sheathing base, 5-8-12 mm. long, the limb about 1 mm. wide; sheath 2-3 mm. long, with hyaline margin; apex acuminate, aristate; arista red to pellucid, serrate; margin serrate nearly to sheath, plane to erect, the unistratose border of the limb very narrow; costa excurrent, with few teeth at back at tip; lamellae 32-50, entire or indistinctly crenulate, 4-6 cells high; *in cross section the marginal cells transversely oval, from not at all to rather thick walled*, about 20 μ wide, smooth; cells of leaf-sheath at margin very narrow, 45-105 μ long, 11-17 μ wide, about 4-8 times as long as wide; cells of unistratose border at $\frac{3}{4}$ up mostly squarish, 10-20 μ , the cuticle distinctly longitudinally striate. Dioicous; male plants intermingled with the female, innovating from the center of the inflorescence, male bracts obovate, with a serrate arista; perichaetial leaves little differing from the upper foliage leaves, spreading from their middle; the sheath yellowish-green, not membranous; calyptra as long or longer than the capsule, light yellowish-brown; seta 4-8 cm. long; slender, shining, undulate, twisted to the right, dark-brown below, yellowish-brown above; capsule erect to pendent, rather weakly but acutely 4-5-angled, greenish-yellow to yellowish-brown; urn oblong, sometimes unsym-

metric through swelling on one side in lower half, about 1.5–3 mm. thick and 3–6 mm. long; neck not or only indistinctly constricted; lid $\frac{1}{2}$ – $\frac{3}{4}$ as long as the urn, depressed-conic, beak curved, pale; epidermal cells of the capsule 4–6-angled with rounded angles, rather thick-walled, 7–10 μ wide, 10–15 μ long in median part of urn, *without central thin spot*; stomata restricted to the neck region, numerous, about 85 μ , the pore slit-like; spore tissue with 4 interior ridges but almost terete, with loosely filamentous tissue both interior and exterior to it; basal membrane about 90 μ high; teeth 64, regular, 90–200 μ long, 35–50 μ wide, papillose; spores 8–17 μ , finely punctate, ochroleucous. Type locality, Ohio (Provost).

ILLUSTRATIONS:—Bot. Gaz. 13: pl. 17. f. a and e; Proc. Wash. Acad. Sci. 12: 313. f. 20; Jennings Man. Mosses W. Pennsylvania pl. 28 in part; Bryol. 6: pl. 8. f. 1., 10–11; Grout, Mosses with Hand-lens & Microscope f. 15 (1–4, 10–12), 16a and 17c, Mosses W. H-lens pl. 11 and f. 8; Pl. 62A.

EXSICCATI:—Grout, N. Am. Musci Perf. 1, Hand-lens Mosses 16; Holz. Musci Acro. Bor. Am. 50, 124, 300; Macoun, Can. Musci 588; Sharp, Fl. Tennessee Bryo. 78, 100.

On soil and rocks. Labrador to Quebec, Minnesota and Alaska, southward to North Carolina, Alabama, Missouri and Oregon; Europe.

Examination of European material of *P. decipiens* leaves one with the conclusion that it is *P. ohioense*. Bauer's Musci Eur. Am. Exsic. No. 2050b for example, from Bavaria, would unhesitatingly be pronounced *P. ohioense* if gathered in Ohio. The terminal cells of the lamellae in cross sections of leaves are wide like those in typical *P. ohioense*.

I have examined material of *P. Smithiae* from Maine and Pennsylvania as well as the type material from Mt. Mansfield, Vt. It seems to me to be unquestionably *P. ohioense* growing under difficulties probably on account of the altitude. All the material I have seen was collected on mountains. *P. ohioense* is a lowland form. *P. Smithiae* agrees with it in all essential characters, but the capsules are slightly smaller and so are the leaves. With smaller leaves go smaller leaf cells as one would expect. I have no hesitancy in referring it to *P. ohioense*, considering it not worthy of a variety.

4. POLYTRICHUM SWARTZII, Hartm. Skand. Fl. (Ed. 5) 361. 1849.

Polytrichum alpestre Sw. Summ. Veg. Scand. 1814. Not of Hoppe Bot. Tasch. 198. 1801.

Polytrichum remotifolia Schwaegr. Suppl. 12: 320. 1816. Not of Beauv. Prodr. 86. 1805.

Polytrichum commune var. *Swartzii* Hartm. Skand. Fl. (Ed. 9) 2: 43. 1864.

Polytrichum algidum Hag. & Jens. Medd. om Groenland 15: 384. f. 1–4. 1897.

Polytrichum commune var. *nigrescens* Warnst. Verh. Bot. Ver. Brandenburg 41: 65. 1899.

Polytrichum inconstans Hag. Nyt. Mag. Naturvid. 38: 339. 1900.

Polytrichum Swartzii var. *nigrescens* Hag. Danske Kgl. N. Videns. Saellsk. Skrift. 1913 (1): 53. 1914.

Plants gregarious, green to black, rather narrow; stem simple or forked, up to 5 cm. long, sometimes innovating from the base, nude below, distinctly triangular when dry, about 400 μ thick, polytrichoid, suddenly leafy upward, rhizoidous from base to well up the stem; leaves somewhat rigid, the lower spreading when moist, the upper erect, shining, about 5 mm. long, narrowly lanceolate from a sheathing base, about 3.7 mm. long and 440 μ wide above the sheath; sheath entire, rectangular, dark yellow, widely hyaline, about 1.3 mm. long and 740 μ wide, 1 cell thick, the cells rather thick walled and near the margin linear; apex ending in a smooth reddish arista composed of the excurrent costa, acute; margin erect, from the sheath dentate or only so toward tip, rarely entire, erect, or incurved, the unistratose portion 2–6 cells wide; costa 350 μ wide, more or less keeled toward the apex, smooth or somewhat toothed on the back, well defined in the sheath; cells of the median region of the sheath 76–114 x 9–13 μ ; cells of unistratose margin isodiametric to wider than long, or longer than wide, 9–19 μ in longest diameter, moderately thick walled; lamellae 30–40, 4–9 cells high, subcrenulate to entire; *the marginal cells mostly wider than high, thin walled to slightly thicker and brownish, smooth, mostly flat-topped or slightly notched in cross section*. Dioicous; calyptra extending well below the capsule, yellowish-brown to almost black; perichaetial leaves with long sheath, with wide hyaline margin; seta 5–8 cm. long, red; capsule cubical-ovate, sharply 4-angled, finally horizontal; urn about 3 mm. long, reddish-brown when old; teeth of the peristome 64, about alike in size; lid half as wide as the urn, arched or flat, thin, with a curved beak; epidermal layer of capsule of isodiametric cells, thick walled, *with distinct thin spot in each cell*; hypophysis distinctly constricted from the urn; stomata present. Type locality, Near Stockholm, Sweden.

ILLUSTRATIONS:—Medd. om Groenland 15: 384. f. 1–4; Proc. Wash. Acad. Sci. 12: 314. f. 21; Schwaegr. Suppl. 1 (2): pl. 97; Pl. 62B.

On soil in wet places. Greenland; Yukon; Iceland; Europe; Asia.

5. *Polytrichum commune* Hedw. Sp. Musc. Frond. 88. 1801.

- Polytrichum propinquum* R. Br. Parry's Voyage Suppl. 294. 1824.
Polytrichum quadrangulare Gilib. Steud. Nom. Crypt. 353. 1824.
Polytrichum commune var. *minus* Brid. Bryol. Univ. 2: 150. 1827.
Polytrichum commune var. *humile* Sw. Annot. Bot. 141. 1829.
Polytrichum commune var. *uliginosum* Hueb. Muscol. Germ. 535. 1833.
Polytrichum commune var. *fastigiatum* Wils. Bryol. Brit. 212. 1855.
Polytrichum cubicum var. *fastigiatum* Lindb. Not. Saellsk. Fauna Fl. Foerk. 9: 49. 1867.
Polytrichum cubicum var. *pygmaeum* Lindb. Not. Saellsk. Fauna Fl. Foerk. 9: 118. 1867.
Polytrichum cubicum Lindb. Not. Saellsk. Fauna Fl. Foerk. 9: 119. 1867.
Polytrichum commune var. *yuccaefolium* DeNot. Epil. 330. 1869.
Polytrichum formosum var. *pallidisetum* of Lesq. & James, Man. Mosses N. Am. 264. 1884. Not of Steud. Nom. Crypt. 352. 1824.
Polytrichum commune var. *brevifolium* C. Jens. Medd. om Groenland 3: 354. 1887.
Polytrichum commune var. *canadense* Kindb., Macoun Cat. Can. Pls. 6: 156. 1892.
Polytrichum commune var. *pygmaeum* Paris, Index Bryol. (Ed. 1) 993. 1897.

Plants forming dense sods, these sometimes covering rather extensive areas, dark olive-green; stems 10-20-40 cm. long, unbranched or very rarely forked, 3-angled in the creeping portion, 5- or more-angled in the leafy portion; rhizoidous only on basal portion of stem; leaves spreading or recurved when moist, appressed or merely the tips spreading when dry, lanceolate from a sheathing base, 8-12 mm. long; sheath about 1.5 mm. wide and 3 mm. long; apex acuminate, brown or red, serrate; *margin serrate to the sheath*, plane, of about 1 row of cells; costa excurrent, sharply serrate on back near tip; lamellae 40-70, entire or slightly crenulate, with a central longitudinal groove, 4-9 cells high; *in cross section the terminal cells slightly wider, depressed in the middle, the outer wall not or little thicker*; cells of the median region of the leaf sheath linear, 95-160 μ long, 9-13 μ wide; cells of the unistratose border squarish or transversely rectangular or elliptic, about 9-19 μ in longest diameter. Plants unisexual; male plants shorter, with shorter leaves, repeatedly proliferous from the center; male bracts broadly obovate, shortly acuminate; perichaetial leaves up to 20 mm. long, with long sheath, membranous, with few or no lamellae, aristate; calyptra entirely covering the capsule, yellow or brownish with a silky luster; seta 6-9-12 cm. long, thick, slightly twisted to the right, reddish-brown, shining; capsule erect to horizontal, sharply 4-angled or rarely 5-6-angled, reddish-brown; urn almost cubical to 1.5 times as long as thick, 3-6 mm. long; neck deeply constricted; apophysis very distinct; lid depressed-conic; beak 1 mm. long, straight or slightly curved; annulus wanting; epidermal cells mostly 4-6-angled, thick-walled, about 35 μ , *each with a conical papilla bearing a small elliptic to cleft-like central thin spot*; stomata very large, 2-celled; basal membrane of the peristome about 100 μ high; teeth 64, about equal, about 250 μ long; spores 8-10 μ , smooth, yellowish. Type locality, European.

ILLUSTRATIONS:—Jennings, Man. Mosses W. Pennsylvania *pl.* 29 in part; Bryol. Eur. *pl.* 425; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl.* 7A; Proc. Wash. Acad. Sci. 12: 316. *f.* 22, 23 in part; Braithw. Brit. Moss Fl. 1: *pl.* 9; *Pl.* 63.

EXSICCATI:—Aust. Musci Appal. 235; Drumm. Musci Bor. Am. 279 (as *P. pallidisetum*), 73; Fernald & Wiegand, Fl. Newfoundland 6471, 6475, 6515, 6530, 6537; Grout, N. Am. Musci Perf. 34; Holz. Musci Acro. Bor. Am. 49, 74, 150 (as sterile *P. decipiens* with lamellae largely notched in cross section), 519, 671 (as *P. Jensei*); Macoun, Can. Musci 595; Piper, Pls. Priest Lake, Idaho 348; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 220.

On damp soil, common along margins of ponds or lakes. Greenland to Yukon and Alaska, southward to North Carolina, Florida, Louisiana, Michigan, Minnesota, Wyoming, Arizona, Idaho and California; S. America; Europe; Asia; Africa; Oceanica.

P. commune likes wet situations. But the wet places often dry in summer, in some seasons earlier than in others, thus hindering development and resulting in small plants with small capsules. I have found *P. commune* on almost bare dry rocks; but the rock was the bottom of a shallow pool until about July 1. Around a pond in open pasture one finds the var. *minus* on the outer rim of the *P. commune* zone where the conditions are most difficult on account of dryness.

The only character which seems to be of value is the long perichaetial leaves in var. *perigoniale*. One finds plants, however, which leave one uncertain between the type and the var. *perigoniale*. Thus the var. *perigoniale* consists of those plants with more evident elongation of the perichaetial leaves. We find no characteristics separating the variety sharply, but an extensive study of intergradations and their conditions of growth should be made to determine the value of the variety.

5a. Var. *PERIGONIALE* (Michx.) B. S. G. Bryol. Eur. 21-22: 13. 1844.

Polytrichum perigoniale Michx. Fl. Bor. Am. 2: 293. 1803.

Polytrichum yuccaeifolium var. *perigoniale* Mart. Fl. Crypt. Erlang. 83. 1817.

Polytrichum commune var. *campestre* Wall. Fl. Germ. 1: 201. 1831.

Lamellae 6-9 cells high. Inner perichaetial leaves much exceeding the foliage leaves; beak of the lid straight. Type locality, European.

ILLUSTRATIONS:—Braithw. Brit. Moss Fl. 1: pl. 9. f. B; Proc. Wash. Acad. Sci. 12: 318. f. 23 in part; Pl. 63.

EXSICCATI:—Fernald & Wiegand, Fl. Newfoundland 6531; Macoun, Can. Musci 595a; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 221.

On soil subject to drying out in summer. Newfoundland to Alaska, southward to North Carolina, Wyoming and Washington; Europe; Azores; Australia.

5b. Var. *JENSENII* Moenk., Rabenh. Krypt.-Fl. (Ed. 2) 4: 919. 1927.

Polytrichum commune cubicum var. *integrifolium* Broth. Acta Soc. Fauna Fl. Fenn. 64: 44. 1890.

Polytrichum Jensenii Hag. Medd. om Groenland 15: 444. 1898.

Polytrichum commune var. *integrifolium* C. Jens. Medd. om Groenland 15: 444. 1898. As synonym.

Stems long; leaves not crowded, the sheath almost twice as long as wide; margin somewhat involute at least above, serrate usually from about the middle of the leaf up; leaf teeth rather weak and distant. Type locality, Lapland.

ILLUSTRATIONS:—Holz. Asa Gray Bull. 3: 95-99. f. 6; Proc. Wash. Acad. Sci. 12: 319. f. 24; Pl. 63. Examined:—Bethel, Alaska (Rev. Butzin) July 4, 1925, as *P. alaskanum*. Tanana, Alaska (O. D. Clark) 1911. Source of Deadwood River, Idaho (Frye) 1934. Yellowstone National Park, Wyoming (Aven Nelson 6131).

In sphagnum bogs and on soil. Greenland; Alaska; Wyoming; Europe.

Polytrichum commune cubicum var. *integrifolium* Broth. is the earliest name. We have no means of checking whether there is an adequate description in Acta Soc. Fauna Fl. Fenn. 64: 44. 1890. If there is, the moss should go under the name *Polytrichum commune* var. *integrifolium* (Broth.) C. Jens., Medd. om Groenland 15: 444, 1898.

The var. *Jensenii* differs from the species chiefly in that the former has weak leaf teeth which extend down about half way to the base of the limb. But this does not hold entirely, for on the same plant, in leaves of about the same size and even the same region there is variation in the distance the leaf teeth extend downward. In some leaves the teeth extend nearly to the base of the limb. The teeth are, however, relatively weak, as compared with typical *P. commune*. It does not seem to merit a species in rank. The plants are like the more elongated forms of *P. commune* with less crowded leaves.

5c. Var. *YUKONENSE* (Card. & Thér.) n. comb.

Polytrichum yukonense Card. & Thér. Proc. Wash. Acad. Sci. 4: 329. 1902.

Leaves 4-6 mm. long, about 1 mm. wide, margin erect, entire; lamellae 8-12 cells high; arista red, entire. Type locality, Yukon River, Alaska (W. H. Dall) 1867.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. 4: pl. 22. f. 1a-f; 12: 320. f. 25; Pl. 63.

Examined:—Port Burwell, Quebec (Pere Dutilly 916) Sept. 25, 1936; also the type material.

On soil. Alaska, northern Quebec.

6. *POLYTRICHUM NORVEGICUM* Hedw. Sp. Musc. Frond. 99. pl. 22. f. 1-4. 1801.

Polytrichum Oederi Hedw. Sp. Musc. Frond. 99. 1801. As synonym.

Polytrichum crassisetum Lam. & De Cand. Fl. France (Ed. 3) 486. 1805.

Polytrichum septentrionale Beauv. Prodr. 86. 1805. Not of Brid. Mant. Musc. 4: 198. 1819.

Polytrichum sexangulare Hoppe, Bot. Tasch. 1799: 128. 1800. Also Web. & Mohr, Bot. Tasch. 220. 1807.

Polytrichum helveticum Schleich. Cent. Pl. Helv. 3, No. 16. 1815.

Polytrichum sexangulare var. *nivale* Kindb. Hewdigia 35: 67. 1896.

Plants gregarious, forming a rather dense sod, bright-green to reddish-brown; stems 1-3-10 cm. long, simple or with few branches, 3-angled below, 5-angled where leafy; central strand 3-angled below, 5-angled to terete above; rhizoidous near base only; leaves grading into elamellose bracts below; the larger ones

patent when moist, closely imbricate when dry, linear-lanceolate to lanceolate from a sheathing base, up to 6 mm. long, stiff, the lower glossy; *apex blunt, cucullate; margin entire to shallowly few-toothed at tip, incurved to near sheath*; costa percurrent or slightly excurrent, with a few teeth at back close to tip or smooth; *lamellae 30-50, entire, 4-6 cells high; in cross section the marginal cells ovate-conical, very thick-walled specially on the outer wall, smooth*; cells of the median region of the leaf sheath rectangular, 38-57 μ long, 9-15 μ wide; cells of the unistratose border at $\frac{3}{4}$ up in distinct rows, squarish to oblong, 9-11 μ in longest diameter. Plants unisexual; male plants intermingled with the female; bracts subquadrate, an enlarged sheath with a triangular tip representing the limb; perichaetial leaves longer than the foliage leaves, with longer sheath; the innermost smaller, the limb reduced to an arista; calyptra shorter than the capsule, ferruginous; seta 1.5-4 cm. long, thick, twisted to right above, with cylindrical hollow, reddish-yellow; *capsule erect or inclined, obtusely 6-angled, rarely 4-angled, reddish-brown*; urn oval, about 1.5 mm. thick, 2-3 mm. long, neck constricted from capsule; lid about half as long as the urn, conic, with gradually narrowed beak; *epidermal cells of the capsule small, squarish, thick-walled, without a thin-walled central region*; stomata restricted to the neck, numerous, in 2-3 transverse rows, large, oval, 2-celled, the pore a long cleft; spore tissue with 6 or rarely 4 longitudinal ridges, with loosely filamentous tissue both interior and exterior to it; basal membrane about 120 μ high; teeth 64, unequal, about 120 μ long; spores 15-18 μ , smooth, yellow. Type locality, Norway.

ILLUSTRATIONS:—B. S. G. Bryol. Eur. *pl.* 419; Braithw. Brit. Moss Fl. 1: *pl.* 7A; Hedw. Sp. Musc. Frond. *pl.* 22. f. 1-4; Proc. Wash. Acad. Sci. 12: 231. f. 26; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl.* 6E; *Pl.* 64A.

EXSICCATI:—Allen, Mosses Cascade Mts. 78; Holz. Musci Acro. Bor. Am. 271; Macoun, Can. Musci 585; Drum. Musc. Am. 283 as *P. septentrionale*.

On rather barren soil at high altitudes. Greenland, Melville Island, Herald Island and Alaska, southward to Montana and Oregon; Europe; Asia.

Hedwig's capsule in Sp. Musc. Frond. must have been one which was immature. The leaf tip in his figure 4 is not that of *Pogonatum alpinum* var. *septentrionale*, but is the characteristic tip of the leaf of *Polytrichum sexangulare*. The short leaves of *P. sexangulare* are entire and have the blunt tip with a few teeth on the back. The one confusing thing in Hedwig's figures is the angularity in the capsule, but young capsules of all species of *Polytrichum* are terete. There is no other leaf tip like his figure 4. *P. sexangulare*, therefore, must give way to *P. norvegicum*.

Roell, in Hedwigia 35: 67, 1896, publishes *Polytrichum sexangulare* var. *nivale* Kindb. as a new variety from Mt. Hood, Oregon. While Kindberg's material is not accessible to us, no one has since found this variety and considerable collecting has been done on Mt. Hood since 1888. Anyone well acquainted with *P. norvegicum* knows that the lower leaves are pointed and where they grade into the bracts they have distinct points. From these facts we are inclined to believe that he either had a stunted plant with only the lower leaves or examined leaves from the base of his plant.

7. POLYTRICHUM JUNIPERINUM Hedw. Sp. Musc. Frond. 89. *pl.* 18. f. 6-10. 1801.

Polytrichum juniperifolium Web. & Mohr, Bot. Tasch. 219. 1807.

Polytrichum implicatum Voit. Musc. Frond. & Herbipolitano 59. 1812.

Polytrichum juniperinum var. *rubrum* C. Muell. Syn. Musc. Frond. 1: 219. 1849.

Polytrichum juniperinum var. *alpinum* Schimp. Syn. (Ed. 1) 447. 1860.

Polytrichum behringianum Kindb. Rev. Bryol. 21: 39. 1894.

Plants gregarious, in thin sods to almost solitary, *glaucous-green*; stems 2-4-10 cm. long, nearly always unbranched, 3-angled below, 5-angled above; *rhizoidous only at base*; leaves spreading when moist, erect when dry, lanceolate from a sheathing base, 8-10 mm. long, the limb about 1 mm. wide; *apex aristate, red, serrate; margin entire, widely incurved above the sheath*; costa excurrent, strongly toothed on back above; *lamellae 35-48, finely crenulate by projecting cells, 4-8 cells high; in cross section the marginal cells ovate-conical, very thick-walled specially on the outer wall, smooth*; cells of the leaf sheath long-rectangular, at the margin narrower and colorless; cells of the unistratose border at $\frac{3}{4}$ up in distinct rows, squarish. Dioicous; male plants intermingled with female ones, more slender, with shorter leaves; male bracts the enlarged leaf sheaths with triangular to cuspidate tip representing the limb; perichaetial leaves longer than the foliage leaves, up to 18 mm., with longer arista, their margins white and membranous; calyptra completely covering the capsule, whitish, or brownish only at tip; seta 2-5-11.5 cm. long, thick, slightly twisted to the right, with cylindrical hollow, bright red; capsule erect to horizontal, sharply 4-angled, yellowish green to brown; urn oblong, about 2.5 mm. thick, 3-5.5 mm. long, with a constriction above the hypophysis;

lid about $\frac{1}{3}$ as long as the urn, shortly conic, with short beak; *epidermal cells of the capsule* mostly 5-6 angled, quite thick walled, *each with a thin-walled usually elongate central region*; stomata restricted to the hypophysis and constriction, in 2 transverse rows, large, of 2 or 4 cells; spore tissue with 4 longitudinal ridges, with loosely filamentous tissue both interior and exterior to it; peristome 300 μ long; basal membrane low, about 60 μ high; teeth 64, about equal, 50-60 μ wide, 160-180 μ long, blunt; spores 8-11 μ , smooth, yellow. Type locality, European.

ILLUSTRATIONS:—Rev. Bryol. 60: *pl.* 3-4; Braithw. Brit. Moss Fl. 1: *pl.* 8B; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl.* 6B; B. S. G. Bryol. Eur. *pl.* 423; Hedw. Sp. Musc. Frond. *pl.* 18, *f.* 6-10; Proc. Wash. Acad. Sci. 12: 323. *f.* 27; Jennings, Man. Mosses W. Pennsylvania *pl.* 29; Grout, Mosses W. H-lens *pl.* 12; *Pl.* 64B.

EXSICCATI:—Allen, Mosses Cascade Mts. 79; Aust. Musci Appal. 237; Bartram, Mosses S. Arizona 36; Crandall, Mosses Colorado. 30; Frye, Moss Exsic. 17; Bryo. Olympic Mts. 475; Grout, N. Am. Musci Perf. 17, Hand-lens Mosses 15; Holz. Musci Acro. Bor. Am. 75, 75c, 518 (as var. *alpinum*); Osborn, Bryo. Michigan 3329; Piper, Washington. Fl. 325, Pls. Priest Lake, Idaho, 342, 356; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 218; U. S. Soils Kelp Exped. Alaska 436, 515, 535, 565, 965, 1210, 1212, 1235, 1236, 1238.

On soil, more often in the sun than in shade. Greenland, Hudson Bay, Saskatchewan, Yukon and Alaska, southward to North Carolina, Wyoming, Utah, Arizona and California; Mexico; S. America; southern Oceanica; Europe; Asia; Africa; West Indies.

On mountains above the timber line it is smaller, narrower, the capsule almost as wide as long. This stunted form constitutes Schimper's variety *alpinum*.

7a. Var. ALPESTRE B. S. G. Bryol. Eur. 21-22: monog. 12. *pl.* 424. *g1-g5.* 1844.

Polytrichum alpestre Hoppe, Bot. Tasch. 198. 1801.

Polytrichum affine Funck, Hoppe Bot. Tasch. 43. 1802.

Polytrichum juniperinum var. *gracilius* Wahl. Fl. Lapp. 344. 1812.

Polytrichum juniperinum var. *strictum* Wallm., Liljeb. Svensk. Fl. (Ed. 3) 527. 1816.

Polytrichum strictum Brid. Bryol. Univ. 2: 139. 1827.

Polytrichum juniperinum var. *affine* Fiedl. Syn. Laubm. Meckl. 96. 1844. Not of Roehl. Deutsch. Fl.

3: 58. 1813.

Polytrichum strictum var. *alpestre* Limpr. Laubm. 2: 630. 1895.

Plants in dense tufts, dark green; stems up to 20 cm. long; *rhizoids very numerous, matted, extending well up among the leaves*, sometimes within 2 cm. of the tip of the stem, brown to dirty yellow; leaves more distant, shorter, narrower; *margin entire*; costa toothed on back to near the sheath; lamellae 25-35. Capsule 1-1.25 times as long as wide. Type locality, European.

ILLUSTRATIONS:—B. S. G. Bryol. Eur. *pl.* 424; Jennings, Man. Mosses W. Pennsylvania *pl.* 19 in part. Braithw. Brit. Moss Fl. 1: *pl.* 8C; Schwaegr. Suppl. 1 (2): *pl.* 97 in part; Dixon & Jam. Stud. Handb. Brit. Mosses (Ed. 3) *pl.* 6C; *Pl.* 64B.

EXSICCATI:—Aust. Musci Appal. 238; Drumm. Musci Bor. Am. 281; Fernald & Weigand, Fl. Newfoundland 6473, 6492; Grout, Hand-lens Mosses 18; Holz. Musci Acro. Bor. Am. 619; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 219; U. S. Soils Kelp Exped. Alaska 100, 457, 475, 1207, 1208, 1305.

In peaty bogs and on moors. Greenland to Alaska and Yukon, southward to North Carolina, Wyoming and Washington; S. America; Europe; Asia.

There seems to be no definite character upon which to base this except that the stem is rhizoidous up into the leaves.

7b. Var. WAGHORNEI Kindb., Macoun Cat. Can. Pls. 6: 155. 1892.

Stems not densely rhizoidous up into the leaves; *leaves somewhat serrate near tip*; marginal cells of the lamellae papillose. Type locality, Deep Water Creek, Venison Tickle and Cape Charles, Labrador (Rev. A. Waghorne).

On soil. Labrador.

I have been unable to see authentic var. *Waghornei*. It seems to me that specimens with stems not densely rhizoidous up into the leaves, with leaves slightly serrate near the leaf tip, belong here. More collections are desirable. On strongly incurved margins one would not expect serrations.

8. *POLYTRICHUM PILIFERUM* Hedw. Sp. Musc. Frond. 90. 1801.*Polytrichum pilosum* Neck. Meth. Musc. 123. 1774.*Polytrichum Hoppii* Hornsch. Flora 1: 106. 1819.*Polytrichum pilifolium* Gray, Nat. Arr. Brit. Pl. 1: 720. 1821.*Polytrichum piliferum* var. *Hoppei* Rabenh. Deutsch. Krypt.-Fl. 2 (3): 238. 1848.*Polytrichum laevipilum* Hampe, Linnaea 30: 459. 1859.*Polytrichum piliferum* var. *laevipilum* Sull. & Lesq. Musci Bor. Am. (Ed. 2) No. 55.

Plants loosely caespitose, glaucous green to brown; stems 2-4-9 cm. long, *nearly always unbranched*, 5-angled; central strand in leafy part terete; its cells with irregularly thickened walls, subdivided by thin transverse walls, the outer 2-3 layers brownish; cortex of interior thin-walled cells which grade into the thick walled epidermis; rhizoids only at base; leaves spreading when moist, erect when dry, long-lanceolate from a sheathing base, up to 6 mm. long, the limb about 0.5 mm. wide; *apex ending in a long white sharply serrate arista* which is reddish at base; margin entire or merely crenulate by projecting cells, *widely incurved above the sheath* so the edges nearly meet; costa excurrent, smooth on back; lamellae 20-40, strongly sinuate or crenulate with projecting cells, 4-7 cells high, *in cross section the marginal cells ovate or flask-shaped, very thick-walled on the outer side, smooth*; cells of the leaf sheath rectangular, 2-2.5 times as long as wide in central region, hyaline at margin; cells of the unistratose border of the limb at $\frac{3}{4}$ up in rather indistinct rows, wider than long, rectangular. Plants unisexual; male plants with shorter leaf awns; male bracts mostly the sheath, obcordate, apiculate, lamellose only at tip; perichaetial leaves longer than the leaves; the inner thin, hyaline, without lamellae, long-aristate; calyptra covering the capsule, light-brown; seta 2-3.5 cm. long, flexuose, chestnut-brown to paler; capsule small, erect to inclined, sharply 4-angled; urn cubical to shortly prismatic, 1.5-2 mm. thick, 2-2.5 mm. long; neck constricted; lid depressed-conic, narrowed to a short beak, orange or red; annulus simple, persistent, of small cells; epidermal cells 4-6-angled, slightly wider than long to slightly longer than wide, with a large thin-walled central region; stomata in the neck, 2-celled, about 7 μ ; spore tissue with 4 longitudinal ridges, with loosely filamentous tissue both interior and exterior to it; peristome a little more than 200 μ high; basal membrane very low, hardly projecting from the mouth; teeth 64, equal, small, blunt, about 200 μ long; spores 9-12 μ , smooth, yellowish green. Type locality, Germany.

ILLUSTRATIONS:—B. S. G. Bryol. Eur. *pl.* 422; Jennings, Man. Mosses W. Pennsylvania *pl.* 28 in part; Proc. Wash. Acad. Sci. 12: 327. *f.* 30; *Pl.* 64C.

EXSICCATI:—Aust. Musci Appal. 239; Fernald & Wiegand, Fl. Newfoundland 6510; Frye, Bryo. Olympic Mts. 510, 590; Grout, N. Am. Musci Perf. 12, Hand-lens Mosses 17; Holz. Musci Acro. Bor. Am. 125; Macoun, Can. Musci 590; Sull. & Lesq. Musci Bor. Am. (Ed. 1) 217, (Ed. 2) 55; U. S. Soils Kelp Exped. Alaska 484; Drumm. Musc. Am. 278.

On rocky or sandy soil in dry places. Greenland to Alaska, southward to New Jersey, Ohio, Wyoming, Colorado, Utah, Nevada and California; S. America; Europe; Asia; Australia.

8a. Var. *HYPERBOREUM* (R. Br.) C. Muell. Syn. 1: 218. 1849.*Polytrichum hyperboreum* R. Br. Parry's Voyage Suppl. 294. 1824.*Polytrichum boreale* Kindb. Bih. K. Sv. Vetens.-Akad. Handl. 7 (9): 52. 1883.

Stem 3-12 cm. long, *mostly with tufted branches, laxly leafy*, red at base, leaf margin entire, or serrate only near arista; *arista rough, serrate, hyaline or somewhat reddish at base*; marginal cells of the lamellae often less thick-walled than in *P. piliferum*. Type locality, Melville Island.

ILLUSTRATIONS:—Proc. Wash. Acad. Sci. 12: 326. *f.* 29; *Pl.* 64C.

Examined:—Port Burwell, Quebec (Pere Dutilly 1630) Sept. 25, 1936; Lake Tinderman, Yukon (Williams, 1902).

In northern or alpine regions not far from the summer snow line, in meadows. Greenland, Quebec, Melville Island, Yukon, and Alaska, southward to Labrador; Europe; Asia.

NOTE.—Dr. Frye has omitted to state that leaf sections of the Polytrichaceae must be made in the upper median portion of the non-sheathing part of the leaf in order to show characteristic lamella cells. The terminal cells of the lamellae are usually quite different near the base.—A. J. G.

CALYMPERACEAE.*

BY WILLIAM CAMPBELL STEERE, PH. D.

Plants very small to large, growing in more or less extensive tufts *on the trunks or stumps of trees* (rarely on rock or soil); stem without a central strand. Leaves more or less sheathing, *bordered with a hyaline or yellowish margin* made up of narrow cells in one or more layers, or not bordered, with a margin one to several cells thick, *which sometimes bears lamellae*; costa with several rows of median guide cells, and two stereid bands, usually strong, disappearing just below the apex or shortly excurrent, *sometimes bearing propagula at the apex; the inner cells of the sheathing part large*, rectangular to quadrate, smooth, thin-walled, hyaline, comprising the *cancellinae*, which sometimes reach into the lamina; cells of the lamina small, green, usually strongly papillose. Dioicous, rarely autoicous; inflorescences apical, ♂ often lateral, gemmiform, with filiform paraphyses; perichaetial leaves usually little differentiated; seta erect, more or less elongated, rarely very short; capsule erect, usually *elongate-cylindric*, smooth or obscurely striate; stomata lacking; *annulus not differentiated*; peristome inserted below the mouth of the urn, simple *or lacking*; teeth 16, lanceolate, as a rule without conspicuous cross-markings, usually highly papillose and with rudimentary, hyaline membrane; *operculum usually long-beaked*; calyptra reaching to *or below* the base of the capsule, cucullate *or campanulate*, smooth or rough above, spores small.

KEY TO GENERA.

- | | |
|---|-------------------------|
| 1. Leaves with narrow, intra-marginal bands of differentiated, elongated cells (<i>teniolae</i>)
2-12 cells in from the margin (lacking in <i>C. Nashii</i>); calyptra persistent, campanulate. | 2. <i>Calymperes</i> . |
| 1. Leaves without <i>teniolae</i> ; bordered at the extreme margin with serrate wings or pale, elongated cells; calyptra cucullate. | 1. <i>Syrrhopodon</i> . |

1. SYRRHOPODON Schwaegr. Suppl. 2^o: 110. 1824.

Plants growing in compact, green to greenish-brown cushions with more or less radiculose, branching stems from a few mm. to 5-6 cm. high; leaves with imbricate, often conspicuously white base, mostly narrowed upward, varying from straight to crispate and from lanceolate to lingulate or ligulate, with acute or rounded apex, *and having a distinct border, either much thickened or with hyaline or yellowish, much-elongated cells*; costa stout, from nearly percurrent to excurrent, often papillose or spiny on one or both sides; leaf cells throughout upper part of leaf chlorophyllose and roundish or oval to quadrate, rarely smooth, mostly papillose or mamilllose on one or both sides; cells of the erect base mostly hyaline (the *cancellinae*), square to linear, changing abruptly into the green cells of the upper part of the leaf. Dioicous or rarely autoicous; seta erect, elongate and smooth; capsule erect, regular, oval to cylindric, mostly smooth and glossy, chestnut-colored; annulus none; *peristome teeth (16) rarely wanting*, mostly narrowly lanceolate and undivided, sometimes very short and irregular, usually papillose and golden brown; operculum conical and often long rostrate; *calyptra cucullate, the base entire or somewhat split*, the apex often rough; spores usually rough; propagula and gemmae often produced by the leaves, usually growing at the apex and on the uppermost part of the costa, or rarely on the cells of the median leaf-blade on either side of the costa. Type species *Syrrhopodon Gardneri* (Hook.) Schwaegr.

KEY TO SPECIES OF SYRRHOPODON.

- | | |
|---|---|
| 1. Leaf with very thick, doubly-serrate border of undifferentiated cells.
Leaf with hyaline or yellowish border of sharply differentiated, narrow, elongated cells. | 2.
3. |
| 2. Costa more papillose (on the back) in the lower than in the upper half; peristome present.
Costa smoother (on the back) in the lower than in the upper half; peristome lacking. | 1. <i>S. floridanus</i> .
2. <i>S. incompletus</i> . |
| 3. Border extending from basal part to apex, often spinose-dentate.
Border not extending to apex, not spinose-dentate. | 3. <i>S. texanus</i> .
4. |

* Much of this study has been based upon Mr. R. S. Williams' revision of the Calymperaceae of North America, in Bull. Torr. Bot. Club 47: 367-396. 1920. See also Bryol. 26: 46; 26: 47; 27: 34-35.

4. Apex of leaves broadly rounded or retuse, entire; filamentous propagula lacking . . . 4. *S. ligulatus*.
 Apex of leaves acute or obtuse, serrulate; filamentous propagula frequently present
 on upper median surface 5.
 5. Terminal leaves lanceolate, 0.6–1.2 mm. wide 5. *S. parasiticus*.
 Terminal leaves linear-lanceolate, 0.2–0.5 mm. wide 6. *S. filigerus*.

1. *SYRRHOPODON FLORIDANUS* Sull. in Gray, Manual. (Ed. II.) 631. 1856.

In dense, more or less extensive brownish-green cushions; stems branching, up to 3 cm. high; stem leaves incurved or crispate when dry, the upper 4–5 mm. long, from an ovate base, somewhat narrowed to a nearly linear point three to four times longer than the base, with incurved, *doubly serrulate-lamellate borders which often enclose a row of stereid cells* and broadly acute or obtuse serrulate apex; costa not quite percurrent, densely covered on the back, *from the middle to the broadened base* of the leaf, with *high (up to 8 μ)*, almost spine-like papillae, leaf blade with cells highly mamilllose on upper side, nearly smooth or somewhat mamilllose on under side, with cells on upper blade distinct, mostly somewhat angular, *scarcely elongate*, 5–7 μ in diameter. Dioicous, perichaetial leaves not differentiated; pedicel erect, 7–8 mm. long; capsule ovate-cylindric, about 1.75 mm. long, the beaked operculum rather shorter; peristome teeth attached well below the mouth, somewhat irregular, short-lanceolate, pale; spores rough, about 16 μ in diameter. Type locality Florida.

ILLUSTRATIONS:—Sull. Icones Musc. pl. 31; Bull. Torr. Bot. Club 42: pl. 6, 47: pl. 15, fig. 3; Pl. 65, 68.

EXSICCATI:—Sull. et Lesq. Musc. Bor-Amer. (Ed. I), 113; Drummond, Musc. Amer. S. States 37 (as *S. albobaginatulus*); Sull., Musc. Allegh. 171 (as *S. albobaginatulus*); Austin, Musc. Appal. Suppl. I, 487; Holzinger, Musc. Acro. Bor. Am. 66; Grout, N. A. Musc. Perf. 48.

On the trunks of trees, especially palms. Very common in southern and western Florida, also occurring in Georgia, Alabama, Louisiana, and Long Island, N. Y. (*Wickes*).

This species can be confused only with the following, to which it is very closely related. However, the lower half of the costa is rougher on the back, the cells of the upper part of the leaf are less inclined to be slightly elongate, the border often encloses a row of stereid cells, and the peristome is usually present.

2. *SYRRHOPODON INCOMPLETUS* Schwaegr. Suppl. 2: 119. 1824.

S. Hobsoni Hook. et Grev. in Brewst. Edin. Jour. 3: 224. 1824.

S. semicompletus Schwaegr., Suppl. 2: 97. 1827.

Calymperes Hobsoni Grev. Ann. Lyc. N. Y. 1: 271. 1825.

Syrrhopodon Mohrii C. Müll. Linnaea 38: 633. 1874.

S. brachystelioides C. Müll. Nuov. Giorn. Bot. Ital. II. 4: 48. 1897.

S. decolorans C. Müll. Bull. Herb. Boiss. 5: 188. 1897.

Plants in extensive, brownish-green mats with more or less curved and branching stems 1–5 cm. long; stem-leaves 4–5 mm. long, from a rather broad ovate or obovate base, which is serrulate on the margins above, abruptly narrowed to a broadly linear point, with *thickened, doubly-serrulate, homogeneous border* extending to the broadly acute or somewhat rounded serrulate apex; costa not quite percurrent, 60–70 μ wide one-half up leaf and about one-sixth the width of the leaf, denticulate at the apex, *from nearly smooth on both sides below to more or less papillose on the back, especially in the upper half*; cells throughout the upper part of the leaf from nearly square to hexagonal, *often slightly elongate*, the median mostly 5–6 μ wide and 6–8 μ long, mamilllose on the under side; cancellinae filling two-thirds to three-fourths of the leaf-base. Dioicous; inner perichaetial leaves very similar to the stem leaves but smaller; seta 6–7 mm. long; capsule oblong-ovate, small-mouthed, rather over 2 mm. long without the lid, the beaked operculum about two-thirds as long; *peristome a rather pale, smoothish membrane not extending above the mouth, often nearly entire*; spores rough, 16–18 μ in diameter; calyptra slightly rough above. Type locality Cuba.

ILLUSTRATIONS:—Schwaegr. Suppl. 2: pl. 180; Bull. Torr. Bot. Club 47: pl. 15, fig. 4; Pl. 66, 68.

EXSICCATI:—Krypt. Exsic. Musc. Palat. Vindob., No. 1896 (as *S. Hobsoni*).

On the trunks of trees, and on rotten wood. Rare and not usually well developed in Florida, but very common in the American tropics. Usually smaller than the preceding (in Florida).

3. SYRRHOPODON TEXANUS Sull. Musci U. S. 103. 1856.

S. alabamensis Lesq. et Schimp. Ber. St. Gall. Nat. Ges. 1877-78: 413. 1879.

In green cushions with simple or slightly branching, stiff stems 2-5 cm. high; stem leaves more or less crispate when dry, erect-spreading when moist, the upper about 4 mm. long, linear-lingulate, or above often consisting of little more than the stout and very rough costa if bearing propagula, from a usually broader, ovate base, with obtuse, often *spiny-dentate* apex and *hyaline leaf-border* which is from *irregularly dentate to spiny-dentate* almost to the insertion of the leaf; costa stout, vanishing just below apex, *very rough on back* to below the cancellinae with *irregular, low, somewhat forking or spinose papillae*; cells of lamina variable roundish, obscure, 6-7 μ in diameter in upper leaf, perichaetial leaves very similar to upper stem-leaves; seta erect, 1-2 cm. long; capsule ovate-cylindric, contracted at the mouth, about 2 mm. long, with slender beaked lid nearly as long; peristome short, lanceolate, obtuse, with two or three prominent articulations; calyptra descending to base of capsule; spores minutely punctate, about 14 μ in diameter. Type locality Texas.

ILLUSTRATIONS:—Sulliv. Icones Musc. Suppl. pl. 20; Bull. Torr. Bot. Club 47: pl. 16, fig. 16; Pl. 65, 68.

EXSICCATI:—Austin, Musc. Appal. Suppl. I, 488; Holzinger, Musc. Acro. Bor. Am. 142.

Usually on trunks of trees or on rotten wood, but occasionally on rocks, or even on moist soil. Not uncommon in Texas, Florida and Georgia; also reported from Kentucky and Tennessee (*Sharp*); Long Island, N. Y. (*Cain*).

This is perhaps the easiest species of the genus to recognize, from the hyaline, serrate to spinose leaf-border. The spines are especially noticeable at the upper angles of the leaf-base. The verrucose or forked papillae on the back of the costa are also quite characteristic.

4. SYRRHOPODON LIGULATUS Mont. Syll. 47. 1856.

S. crispus Aust. Bot. Gaz. 2: 109. 1877.

Growing in compact, brownish-green tufts with mostly simple stems up to 1.5 cm. high; stem-leaves with conspicuously white, imbricate base, *exceedingly crispate above when dry*, 2.0-2.5 mm. long from an obovate-lanceolate base, entire to serrulate, slightly narrowed to a lingulate, keeled point, from scarcely as long to about one and one-half times longer than the base, *with rounded and often emarginate apex*, which often bears small gemmae; narrow, *hyaline border* usually present *in the lower part of leaf*; costa nearly or quite percurrent, slightly serrulate on the back toward the apex, smooth below, about one-eighth the width of the leaf half way up; *cells of upper blade opaque and very obscure*, not elongate, 6-8 μ in diameter, mamillate and densely verrucose-papillose on both sides, making the upper leaf-margin sharply and finely denticulate; perichaetial leaves about like those of stem; seta 3-4 mm. long; capsule ovate, scarcely 1.0 mm. long; peristome teeth golden brown, projecting well above the mouth, rather rough, with indistinct articulations; spores rough, 12-15 μ in diameter; lid and calyptra not known. Type locality Guiana.

ILLUSTRATIONS:—Bull. Torr. Bot. Club 47: pl. 16, fig. 17; Pl. 66, 68.

EXSICCATI:—Holzinger, Musc. Acro. Bor. Am. 474.

On trees, rare. Known in the United States only from southernmost Florida.

The truncate, often emarginate leaves of this rare species serve to distinguish it from all others.

5. SYRRHOPODON PARASITICUS (Sw.) Besch. Ann. Sci. Nat. VIII. 1: 298. 1895.

Bryum parasiticum Sw. Prodr. Fl. ind. Occ. 139. 1788.

Encalypta parasitica Sw. Fl. ind. Occ. 3: 1759. 1806.

Calymperes parasiticum (Sw.) Hook. et Grev. in Brewst. Edin. Jour. 1: 131. 1824.

Calymperopsis parasitica (Sw.) Broth. Engl.-Prantl. Pflanzenfam. (Ed. 2). 10: 235. 1924.

Plants scattered or in loose tufts, large, stems up to 2 cm. high, stem leaves usually 4-5 mm. long, linear-lanceolate, the basal part often slightly narrower than the upper part, *the terminal leaves much shorter and broader, lanceolate to ovate-lanceolate, up to 1 mm. wide and occasionally broader*, rather gradually acutely pointed, subtubulose and erect-flexuose when dry, widely spreading, *almost squarrose when moist*, with a *yellowish minutely serrulate or entire border of elongated cells* (sometimes lacking in the terminal leaves) extending from about one-third below the apex nearly to the base; costa nearly percurrent, smooth at the back, except at the slightly denticulate apex; cells in the upper part of the blade mamillate on upper, smooth or unipapillate on the under side, mostly hexagonal, the median about 8 μ wide and 8-10 μ long, those on

the upper side next the costa often bearing, *from some distance below the apex to near the cancellinae*, filiform propagula about 0.5 mm. long, with fifteen to twenty cross-walls. Dioicous; perichaetial leaves scarcely differentiated; seta (with vaginule) 3.5 mm. long, bearing an erect cylindric capsule 1.5–1.7 mm. long; capsules usually clustered; peristome consisting of 16 irregular teeth hardly projecting above the rim of the capsule; operculum conic with a filiform beak about two-thirds the length of the capsule; calyptra cucullate, finely plicate, deeply split on one side; spores green, minutely granulose, oval. Type locality Haiti.

ILLUSTRATIONS: Schwaegr. Suppl. 1: *pl. 17*; Bryol. 26: 46 (50), *fig. 1–9*; Bull. Torr. Bot. Club 47: *pl. 16, fig. 18; Pl. 66, 68*.

EXSICCATI:—Holzinger, Musc. Acro. Bor.-Am. 498.

On the bark of trees and shrubs. Occasional in southern Florida, but only rarely fruiting.

The broad terminal leaves which often bear elongate, septate propagula separate this species from all the others but the following, which is smaller and has narrower terminal leaves.

6. SYRRHOPODON FILIGERUS (Aust.) Williams, Bull. Torr. Bot. Club 47: 384. 1920.

Calymperes filigera Aust. Bot. Gaz. 4: 151. 1879.

Calymperopsis filigera (Aust.) Broth. Engl.-Prantl, Pflanzenfam. (Ed. 2). 10: 235. 1924.

In small green cushions with stems short, 3–6 mm. high; leaves 2.5–4.0 mm. long, incurved or very slightly crispate when dry, linear from an oblong base, with an acute or somewhat obtuse, serrulate apex; costa percurrent, sometimes bearing numerous filiform propagula throughout the middle part; border short, rarely extending above the middle and often lacking in the lower part, composed of a yellowish, cylindric band of elongated, thick-walled cells; cells of blade translucent, mamilliose on the upper side, finely papillose on the under side, slightly elongate, somewhat angular, the median 7–8 μ wide and 8–10 μ long. Apparently dioicous; seta (with vaginule) 2.5–3.0 mm. long, bearing an erect, ovate-cylindric capsule, 1.3–1.5 mm. long, contracted at the mouth; operculum long-rostrate, with a beak about 0.5 mm. long; peristome apparently lacking; calyptra cucullate, faintly plicate. Type locality Florida (Austin).

ILLUSTRATIONS:—Bull. Torr. Bot. Club 47: *pl. 16, fig. 19; Pl. 66, 68*.

Known only from the type locality (Caloosa) and from Oviedo, Florida (S. Rapp). Although the type collection was sterile, Rapp's material bears fruit, thus making it possible, for the first time, to describe the sporophytic characters.

2. CALYMPERES Sw. in Weber f. Tab. Calypt. Operc. Musc. Frond. 1813; in Schwaegr. Suppl. 12: 333. 1816.

Plants small to medium sized, growing in compact tufts with erect, often dichotomous stems; stem leaves when dry mostly strongly incurved or crispate and subtubulose above the erect, clasping, usually broader and conspicuously white base, the leaf point varying from lanceolate to lingulate or ligulate with apex often broad; costa stout, vanishing just below the apex or more or less excurrent, *often enlarged and bearing propagula in dense clusters at the apex*, from smooth to rough on both sides, sometimes spinose; leaf margin usually more or less thickened and serrate or rarely with two serrate wings; *ribbon-like bands of green, elongated cells, the teniolae* (lacking in one species), *extend, just within the margin, from base to near apex* in some species, in others only for a short distance in the upper basal part of the leaf; cells of the upper blade roundish to angular, sometimes shortly elongate, chlorophyllose, often rather obscure, mostly mamilliose on the upper side and smooth to somewhat mamilliose and often papillose on the under side; hyaline, rectangular or nearly square cells of the *cancellinae* usually filling most of the basal or sheathing part of the leaf, except a narrow border, and changing abruptly into the green cells of the blade above. Dioicous; *peristome none*; capsule oblong to cylindric, smooth, on an erect, more or less elongate seta; *calyptra persistent, plicate*, rough in upper part, *embracing the base of the capsule and split on the sides only part way down to the base*. Type species *Calymperes lonchophyllum* Schwaegr.

KEY TO THE SPECIES OF CALYMPERES

- | | |
|---|--------------------------|
| 1. Teniolae absent..... | 1. <i>C. Nashii</i> . |
| Teniolae present in at least the leaf-base..... | 2. |
| 2. Green cells about 4 μ in diameter, margin very thick and strongly serrate..... | 4. <i>C. Donnellii</i> . |
| Green cells 6–8 μ in diameter, margin not much thickened..... | 3. |

3. Teniolae only 2-3 rows in from margin in upper leaf-base, upper half of blade entire 2. *C. Richardi*.
 Teniolae 4-8 rows of cells in from margin in upper leaf-base, upper leaf blade and
 apex serrate. 3. *C. emersum*.

1. CALYMPERES NASHII Williams Bull. Torr. Bot. Club 47: 391. 1920.

In very thin, dusky green cushions with stems only 2 or 3 mm. high; leaves strongly incurved or crispate when dry, about 2.5 mm. long, oblong-linear from a slightly or not at all broader base; leaf entire, with a thick, cylindric border of short-rectangular, green cells extending from a little below the apex to the erect or clasping basal part; costa nearly cylindric, about 65 μ wide one-third up from base, papillose on both sides to cancellinae, usually shortly excurrent, slightly enlarged at the apex and bearing numerous short, spindle-shaped propagula about 120 μ long, with six to eight transverse walls; leaf cells of spreading blade mostly not elongate, the median 4-6 μ in diameter, mamilllose on upper side, slightly or not mamilllose but more or less papillose on under side; teniolae wanting; cancellinae extending about one-fourth up the leaf; fruit unknown. Type locality Haiti.

ILLUSTRATIONS:—Bull. Torr. Bot. Club 47: pl. 17, fig. 8; Pl. 67, 68.

Known in the United States only from the extreme southern part of Florida (Dade County).

This species seems to be very close to the following, *C. Richardi*, but the stems are shorter, the teniolae are lacking, the leaf-border is entire and the cancellinae are narrower; otherwise it could be very easily taken for a species of *Syrrhopodon*.

2. CALYMPERES RICHARDI C. Müll. Syn. 1: 524. 1849.

C. Breutelii Besch. Ann. Sci. Nat. VIII. 1: 278. 1895.

C. guadalupense Besch. Ann. Sci. Nat. VIII. 1: 285. 1895.

C. hexagonum Besch. Ann. Sci. Nat. VIII. 1: 286. 1895.

C. Hookeri Besch. Ann. Sci. Nat. VIII. 1: 287. 1895.

C. panamae Besch. Ann. Sci. Nat. VIII. 1: 298. 1895.

In compact cushions with stems sometimes branching, 5-6 mm. high or rarely up to 2 cm.; leaves strongly incurved or crispate when dry, the lower short, ovate, about 0.75 mm. wide by 1.5 mm. long, the upper 3.0-4.5 mm. long from a variable base, sometimes distinctly ovate or obovate and considerably wider than the blade above, sometimes scarcely or not wider than above, and extending into a broadly acute or obtuse point, or those leaves bearing propagula narrowed above into a stout point of variable length, with rounded apex; leaf margin entire except along the upper part of the clasping base, which is more or less irregularly serrulate; costa stout, vanishing just below the apex, rough on both sides above, slightly rough or smooth below the middle and bearing at the apex on the upper side only a dense cluster of narrowly spindle-shaped propagula, up to 250 μ long with ten to fifteen cross-walls; cells of upper leaf mamilllose, distinct, mostly roundish, 6-8 μ in diameter; teniolae two or three cells wide and one to five cells in from the lower margin, extending from the upper part of the leaf-base and running into the thickened border toward the apex of the leaf; cancellinae extending one-third to one-fourth up the leaf; perichaetial leaves much like stem-leaves, but larger below, with cancellinae extending higher up; seta erect, about 3 mm. long; capsule 1.5 mm. long, elongate-oval, smooth, without peristome; lid short-rostrate; spores rough, up to 35 μ in diameter. Type locality Guiana.

ILLUSTRATIONS:—Bull. Torr. Bot. Club 47: pl. 17, fig. 1; Prodr. Fl. Bryol. Surinam., pl. 3; Pl. 67, 68.

EXSICCATI: Austin, Musc. Appal. Suppl. I, 489; Grout, Musc. Perf. 323.

On the bark of trees and shrubs. Although only occasionally found in Florida, this is apparently the most common species of the genus in the United States.

It is readily distinguished by the very short and broad basal leaves and by the elongated apical leaves, in well developed plants, which often bear a terminal brush-like group of fusiform propagula.

3. CALYMPERES EMERSUM C. Müll. Bull. Herb. Boiss. 5: 189. 1897.

In broad, lax, dull-green tufts with stems about 1.5 cm. high; stem leaves about 4 mm. long, mostly incurved, often scarcely crispate when dry, from a somewhat wider, or in the lower leaves narrower, oblong or obovate, serrulate base extending into a broad, oblong-linear point, from not much longer than the basal

part to about twice longer, with rather abruptly acute, serrulate apex and costa vanishing just below apex or when bearing propagula, excurrent and enlarged into a stout rough point, *with the propagula on all sides* near the apex; costa in the middle of the leaf about one-tenth the width of leaf, rough on both sides in upper half; blade of leaf highly mamilllose and papillose on the upper side, the under side not mamilllose but finely papillose; cells throughout spreading leaf blade distinct, scarcely or not elongate, angular to roundish, 7-8 μ in diameter, with one or sometimes two papillae on each surface; *teniolae extending from or near the base to near the abruptly narrowed apex and only one or two cells in from the margin in the upper part of the leaf, but four to eight cells in from margin at the broadest basal part; cancellinae often extending nearly one-half up leaf next the costa; capsule scarcely emergent.* Type locality, Guatemala.

ILLUSTRATIONS:—Bull. Torr. Bot. Club 47: pl. 17, fig. 3; Pl. 67, 68.

EXSICCATI:—Grout, Musc. Perf. 322.

Known only from the type locality and from two stations in southern Florida, Deering Hammock (Small) and Hattie Bauer Hammock (Grout), both in Dade County, and in Myaka City, Manatee Co., Florida.

This rare species is distinguished from the preceding by the somewhat longer stem-leaves from a wider base, which bear propagula on all sides of the costa. Also, the teniolae extend farther toward the leaf insertion.

4. CALYMPERES DONNELLII Aust. Bot. Gaz. 4: 151. 1879.

C. rufescens Besch. Ann. Sci. Nat. VIII. 1: 302. 1895.

C. Brittoniae Besch. Ann. Sci. Nat. VIII. 1: 278. 1895.

C. Smithii Besch. in Par. Ind. Musc. (Ed. I.) 1255. 1898.

C. portoricense Ren. et Card. Bull. Soc. Bot. Belg. 41 (1): 57. 1904.

C. Richardi C. Müll. var. *Donnellii* Lesq. and James Man. 184. 1884.

In extensive green mats with stems from 3 mm. to 1 cm. high; *leaves incurved or crispate when dry*, the lower 2.5-3.0 mm. long, the upper about 5 mm. long, from a mostly slightly broader, more or less ovate base one-third to one-fourth the entire length of the leaf, extending into an oblong-linear blade with broadly acute apex, or those bearing propagula usually abruptly narrowed to a rough stout point of variable length; *leaf margins incurved, doubly and irregularly serrate above, with thickened margin*, below minutely serrulate; costa stout, often very rough on inner face above, and on back from apex to near the cancellinae; cells throughout upper leaf mamilllose and papillose, *roundish, mostly 4-5 μ in diameter, teniolae distinct to the insertion of the leaf, eight to twelve cells in from the margin in the broadest part of the leaf, extending about one half up leaf and disappearing in the thickened border*; cancellinae extending one-third to one-fourth up leaf; perichaetial leaves few, *only about one-half as long as upper stem-leaves*, enclosing numerous, very long paraphyses; seta dark red, erect, 5 mm. long; capsule cylindric, about 2 mm. long; calyptra scabrous above, spores rough, about 18 μ in diameter. Type locality Caloosa, Florida.

ILLUSTRATIONS:—Bull. Torr. Bot. Club 47: pl. 17, fig. 5; Pl. 67, 68.

Known in the United States from central and southern Florida, from sterile material only.

The exceedingly small cells and the doubly serrate leaf-margins make it possible to separate this species readily from its congeners.

* Omitted by mistake from page 90. Adapted from N. Am. Flora 15²: 136. 1913.

CAMPYLOPUS SCHIMPERI Milde, Crypt.-Fl. Süd-Tirols (Bot. Zeit. Beil.), 13. 1864.

Campylopus frigidus Lesq. in Porter and Coult. Syn. Fl. Colo. 155, in part. 1874.

Leptotrichum tomentosum Kindb. Ottawa Nat. 7: 18. 1893.

Plants in compact tufts, 2-3 cm. high, with stems reddish-tomentose below and yellowish-brown at the summit; leaves about 3 mm. long, closely appressed when dry, gradually lanceolate from an oblong base, tubulose above, entire on the margin to near the apex; costa excurrent nearly half its length, more or less ribbed on the back, about 120 μ wide near the base and extending two-thirds across the leaf-base, *without stereid-bands*, in cross-section showing a row of large, thin-walled cells on the ventral side with 2 or 3 rows of smaller cells beneath; alar cells red to hyaline, the cells just above pale, thin-walled, rectangular, toward the margin very narrow, farther up all more or less oblong to oval and rhomboidal with slightly thickened, scarcely or not pitted walls.

Type locality: Europe.

Arctic-alpine, on rocks and soil: Greenland, St. Paul Island, Alaska, Rocky Mountains of Colorado, also in Europe.

ILLUSTRATIONS: Dixon's Handbook British Mosses. Ed. 3, plate 11 L: Braithw. Brit. Moss Flora, V. 1: *plate 18 C; Pl. 48 E.*

PLATE 39. A. *Angstroemia longipes* (from Bry. Eur. *pl.* 94). 8, upper stem leaf; 8a, 8b, apical and basal leaf cells of the same; 10, 11, perigonal leaf, antheridia and paraphyses; 14, perichaetium; 15, 16, 17, perichaetial leaves in order; 15a, apex of perichaetial leaf; 19, 20, 28, capsules; 22, 23, opercula; 24, 25, 26, peristome teeth.

B. *Rhabdoweisia denticulata* (from Bry. Eur. *pl.* 42). 5, 9, leaves; 5a, 5b, apical and basal cells of 5; 12-15, capsules; 16, portion of peristome; 17, lateral view of peristome tooth.

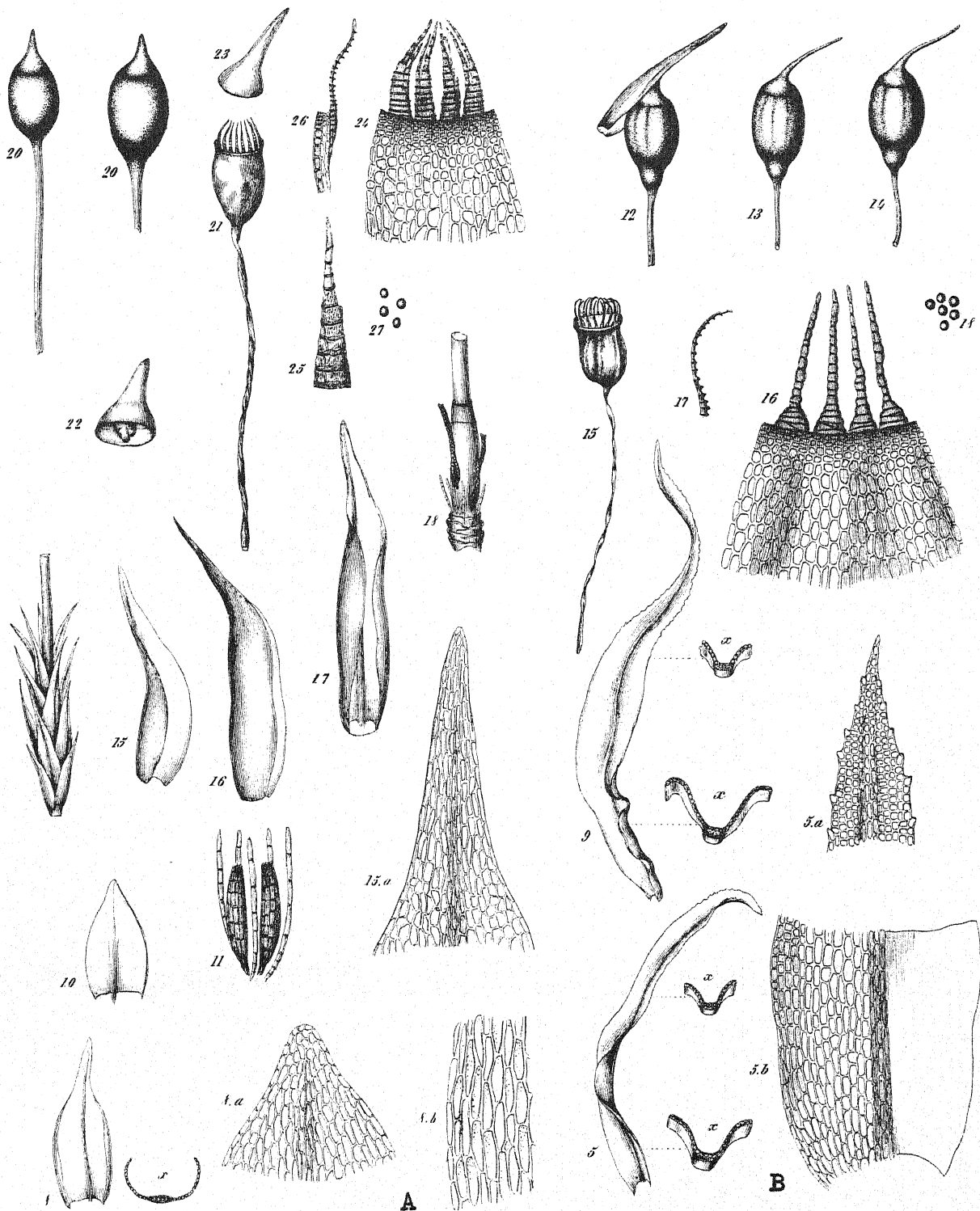
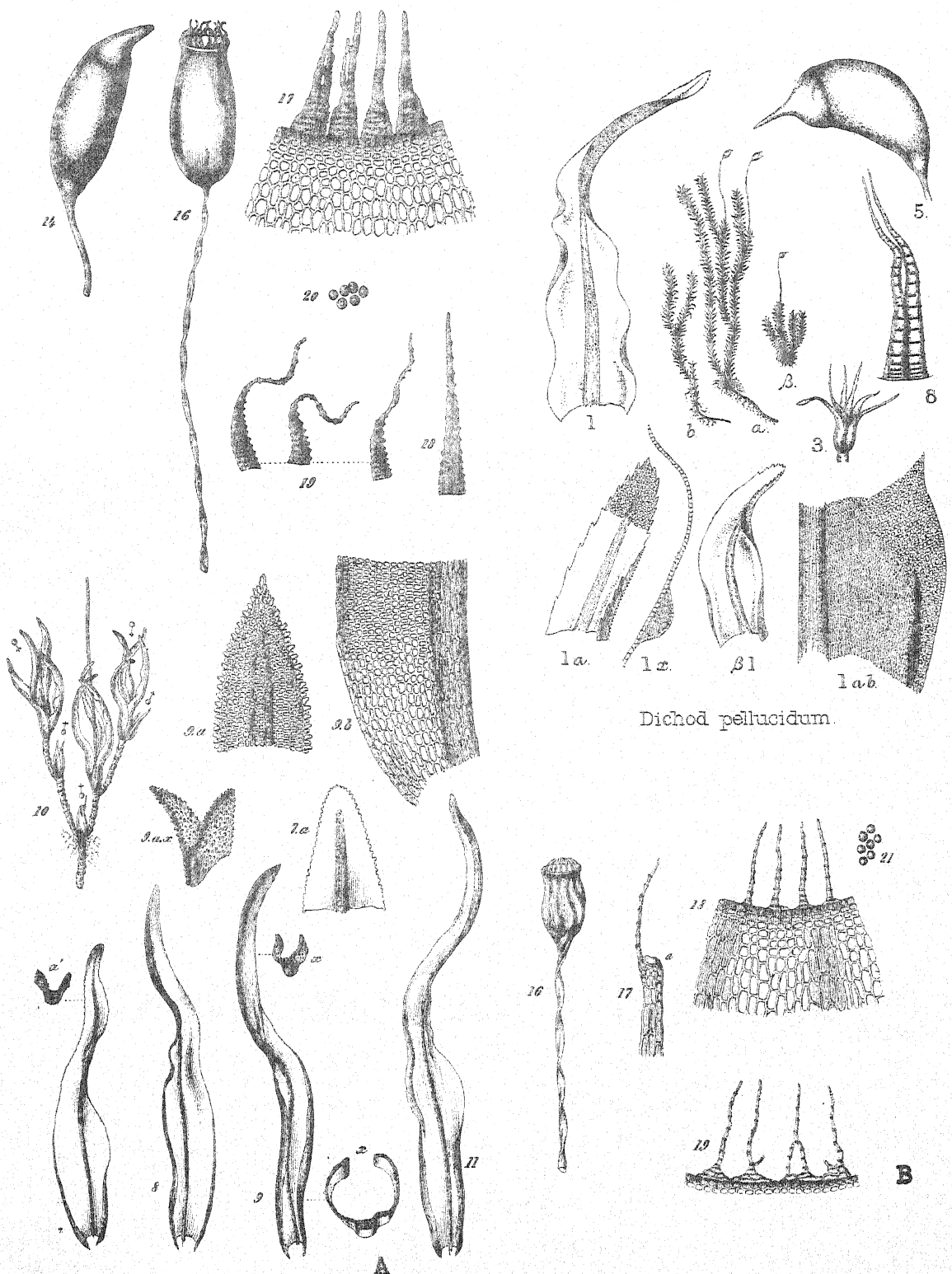


PLATE XXXIX.

PLATE 40. A. *Oreoweisia serrulata* (from Bry. Eur. pl. 27). 7, 8, 9, 11, leaves; 10, inflorescence; 7a, 9a, leaf apices; 9b, leaf base; 9ax, portion of leaf showing papillae; 14, 16, capsules; 17-19, peristome teeth.

B. 16-19, capsule and peristome of *Rhabdoweisia fugax* (from Bry. Eur. pl. 41).

D. *Dichodontium pellucidum* (from Braithw. Brit. Moss Fl. pl. 24D). For description see plate 42C.



Dichod pellucidum.

PLATE 41 (upper part). A. *Dichodontium olympicum* (from Bot. Gaz. 30: pl. 2). a, plant, $\times 1$; b, b, b, leaves, $\times 32$; c, basal areolation, $\times 135$; d, marginal areolation in the upper part, $\times 260$; e, cross section of the costa, $\times 260$; f, capsule, $\times 26$; g, peristome tooth, $\times 105$; h, upper portion of the same, $\times 285$.

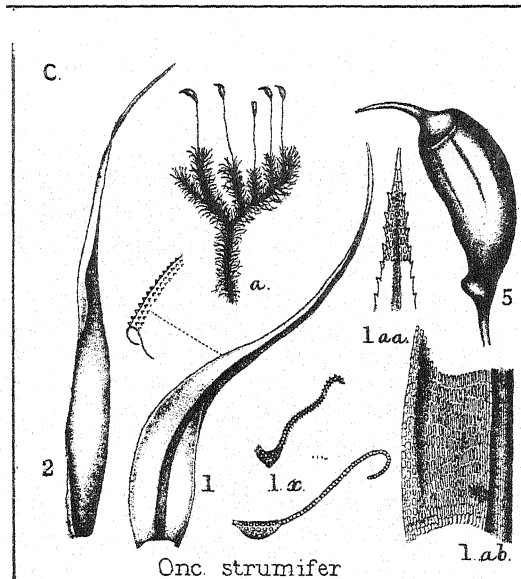
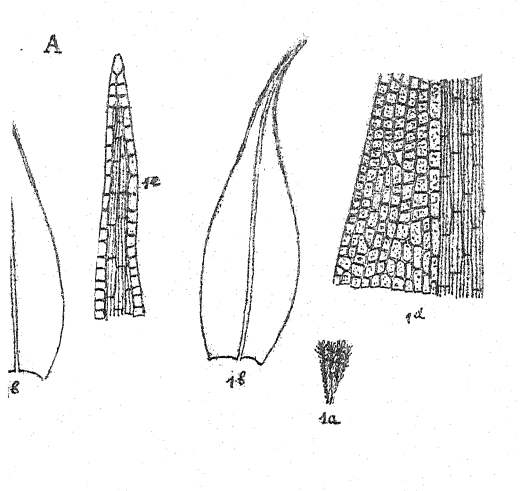
B. *Oncophorus Jenneri* (from Dixon, Handb. Brit. Mosses pl. 10A. by permission). Leaf, $\times 15$; leaf cells about $\frac{1}{3}$ from apex, $\times 180$; cross section of leaf, $\times 180$; dry and empty capsule, $\times 10$.

Lower part (from Broth. Laubm. Fennoskand. f. 15, by permission). A-D. *Oncophorus Schisti*. A, plant, $\times 1$; B, stem leaf, $\times 22$; C, apex of same, $\times 125$; D, peristome. E-J. *Oncophorus alpestre*. E, fruiting plant; F, stem leaf; G, leaf apex more enlarged; H, capsule; J, peristome. K-N. *Oncophorus tenellus*. K, stem leaf; L, apex of the same; M, capsule; N, peristome.

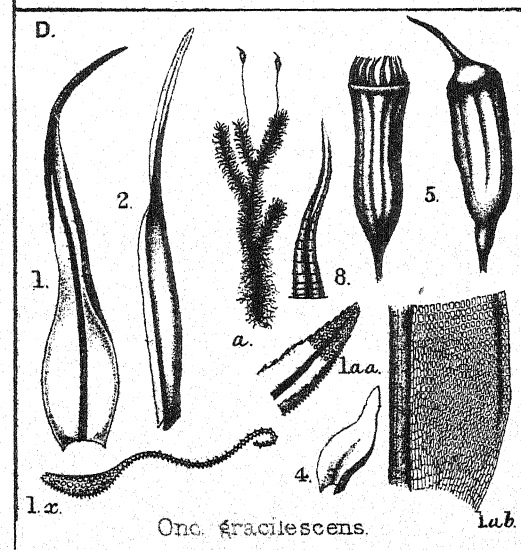
PLATE 42. *A. Dicranoweisia subcompacta* (from Bot. Gaz. 30: pl. 11). *a*, plants, $\times 1$; *b*, leaves, $\times 32$; *d*, median and *e*, apical areolation, $\times 135$.

C. Oncophorus polycarpus var. *strumiferus*. *a*, fertile plant, $\times 1$; *1*, leaf enlarged; *1x*, cross section of leaf; *1aa*, leaf apex; *1ab*, areolation of base; *2*, perichaetial leaf; *3*, male bud; *4*, perigonal bract, antheridium, and paraphyses (*3*, *4* and *8* not found in *C*); *5*, capsule; *8*, peristome.

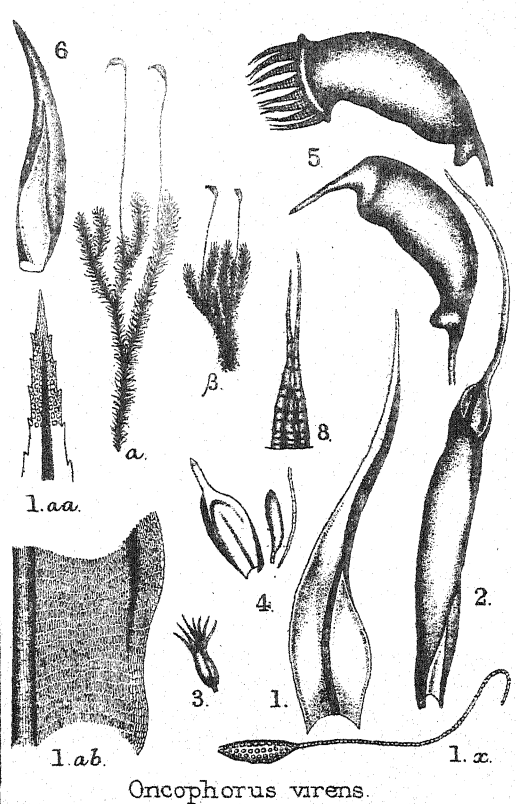
B, *D*, *E*, as indicated, description as in *C*. (*B-E* from Braithw. Brit. Moss Fl. 1: pl. 25).



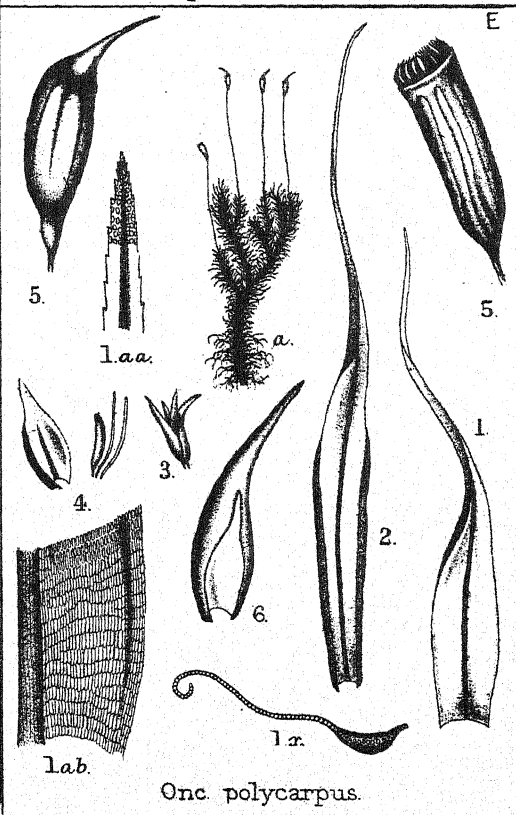
Onc. strumifer



Onc. gracilescens.



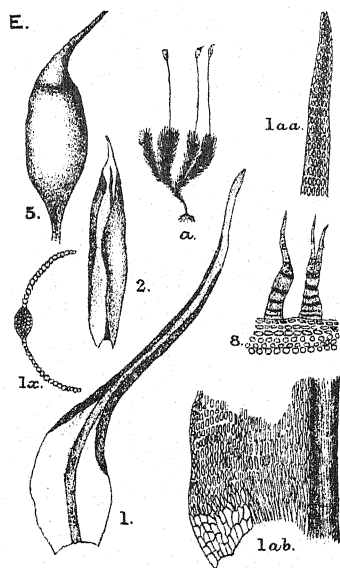
Oncophorus virens.



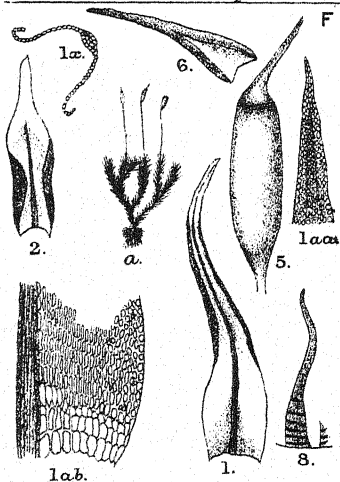
Onc. polycarpus.

PLATE 43. *E, F, G*, on left margin from Braithw. Brit. Moss Fl. 1: *pl. 19*. Species as indicated; description under *pl. 42*.

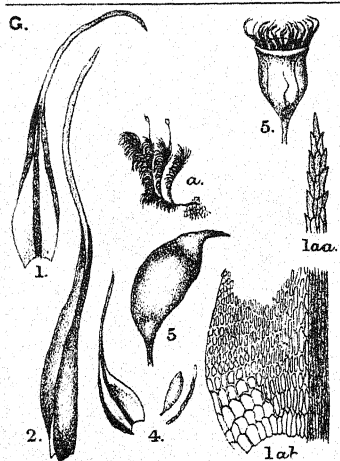
On the right, Dixon, Handb. Brit. Mosses *pl. 13* (by permission). Species as indicated, description under *pl. 46*.



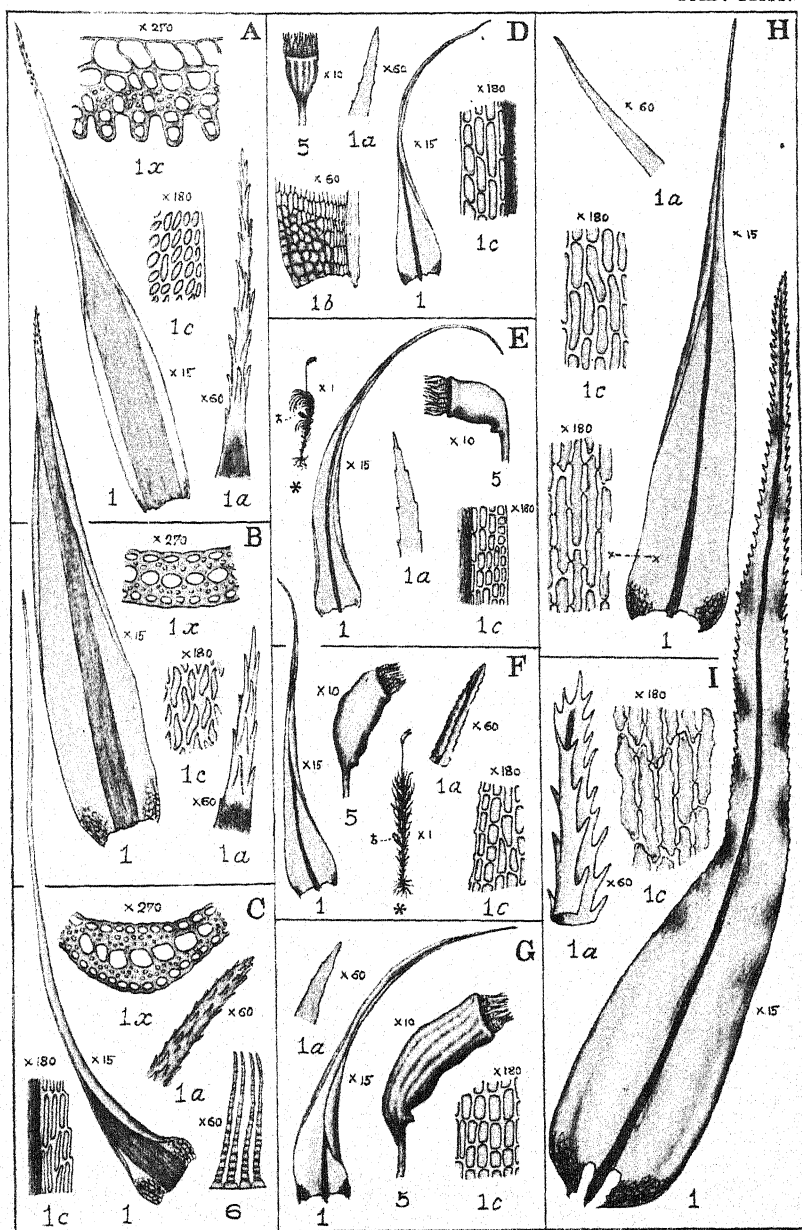
Dicranow. crispula.



Dicranow. cirrata.



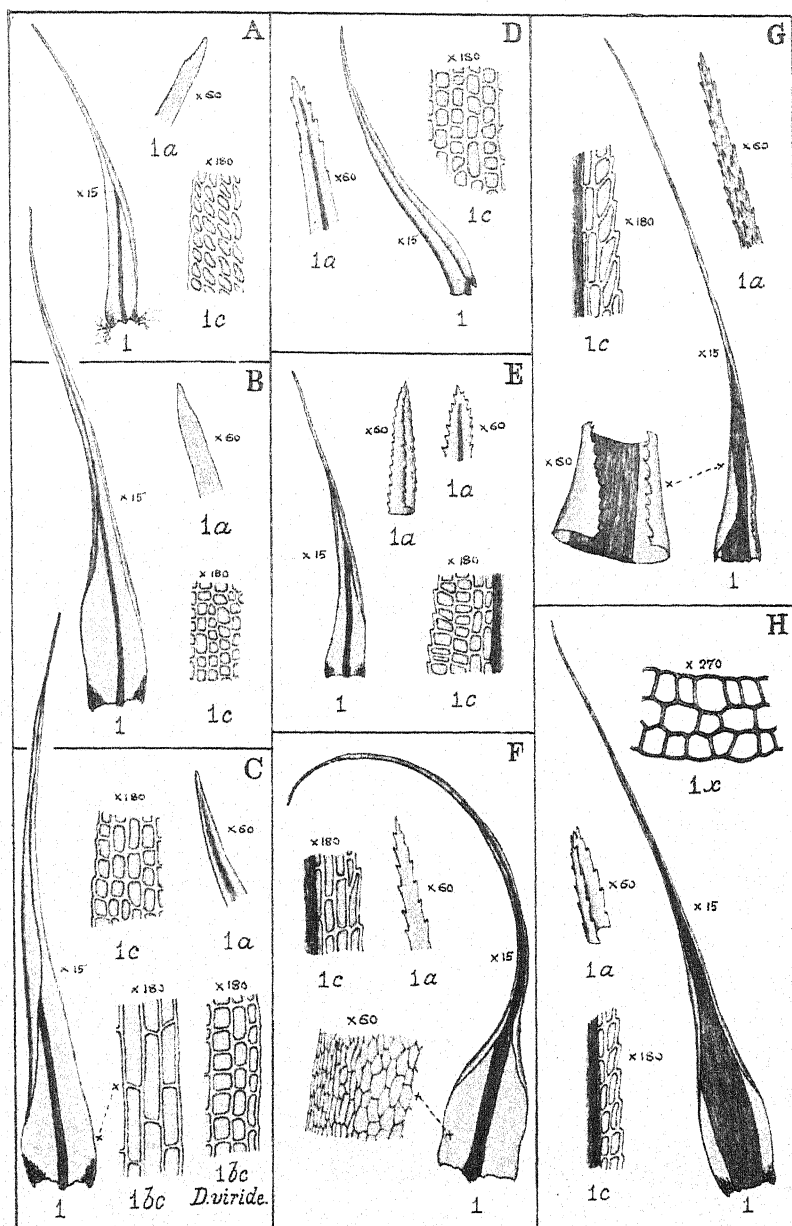
Dicran. fulvellum.



A. *Campylopus introflexus*. B. *C. brevipilus*. C. *Dicranodontium longirostre*.
D. *Dicranum fulvellum*. E. *D. falcatum*. F. *D. schisti*. G. *D. Starkii*.
H. *D. molle*. I. *D. undulatum*.

PLATE 44. *A-H* (at left) Dixon, Handb. Brit. Mosses pl. 15 (by permission).
Species as indicated; description under *pl.* 46.

At right, *Arctoa Blythii* var. *hispidula* (from Bull. N. Y. Bot. Garden 2: *pl.* 34. 1, plant, $\times 1$; 2, leaf, $\times 34$; 4, inner perichaetial leaf, $\times 34$; 6, 7, cross sections of leaf, 6×285 and 7×400 ; 10, leaf apex $\times 160$; 12, capsule, $\times 16$; 13, calyptra, $\times 16$.



A. *Dicranum elongatum*. B. *D. Scottianum*. C. *D. strictum*. D. *D. flagellare*.
E. *D. montanum*. F. *D. uncinatum*. G. *D. asperulum*. H. *D. longifolium*.

PLATE XLIV.

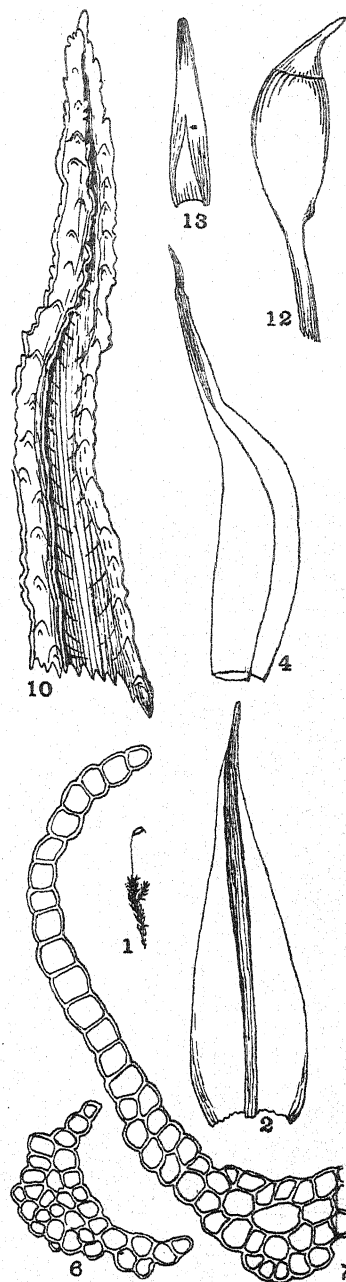


PLATE 45. 1-5, *Symblepharis helicophylla*. 1, plant, $\times 2$; 2, leaves, $\times 25$; 3, median leaf cells, $\times 250$; 4, basal leaf cells, $\times 250$; 5, capsule, $\times 17$; 6-11, *Dicranoweisia Roellii*. 6, plant, $\times 2$; 7, leaves, $\times 25$; 8, perichaetial leaf, $\times 25$; 9, basal cells, $\times 250$; 10, median cells, $\times 250$.

12-15, *Oncophorus strumulosus*. 12, plant, $\times 2$; 13, leaves, $\times 25$; 14, basal leaf cells, $\times 250$; 15, upper median leaf cells, $\times 250$.

16-22, *Arctoa hyperborea*. 16, plant enlarged; 17, leaves, $\times 25$; 18, basal leaf cells, $\times 250$; 19, upper leaf cells, $\times 250$; 20, 21, capsules operculate and dry and empty; 22, cells of capsule mouth, annulus and peristome teeth. (16 and 20-22 redrawn from the Bry. Eur. *pl.* 87; all the other figures of this plate by Seville Flowers.)

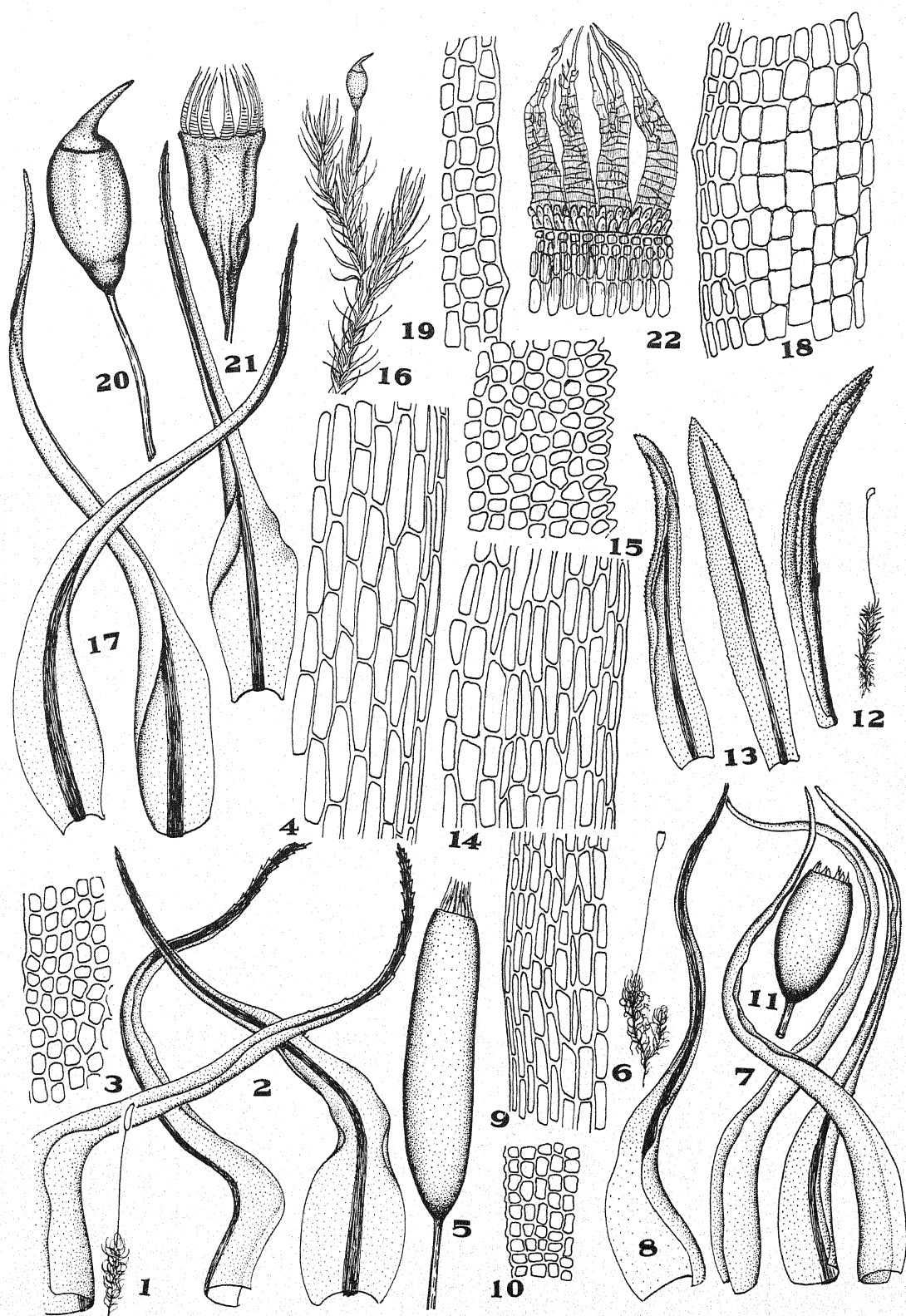
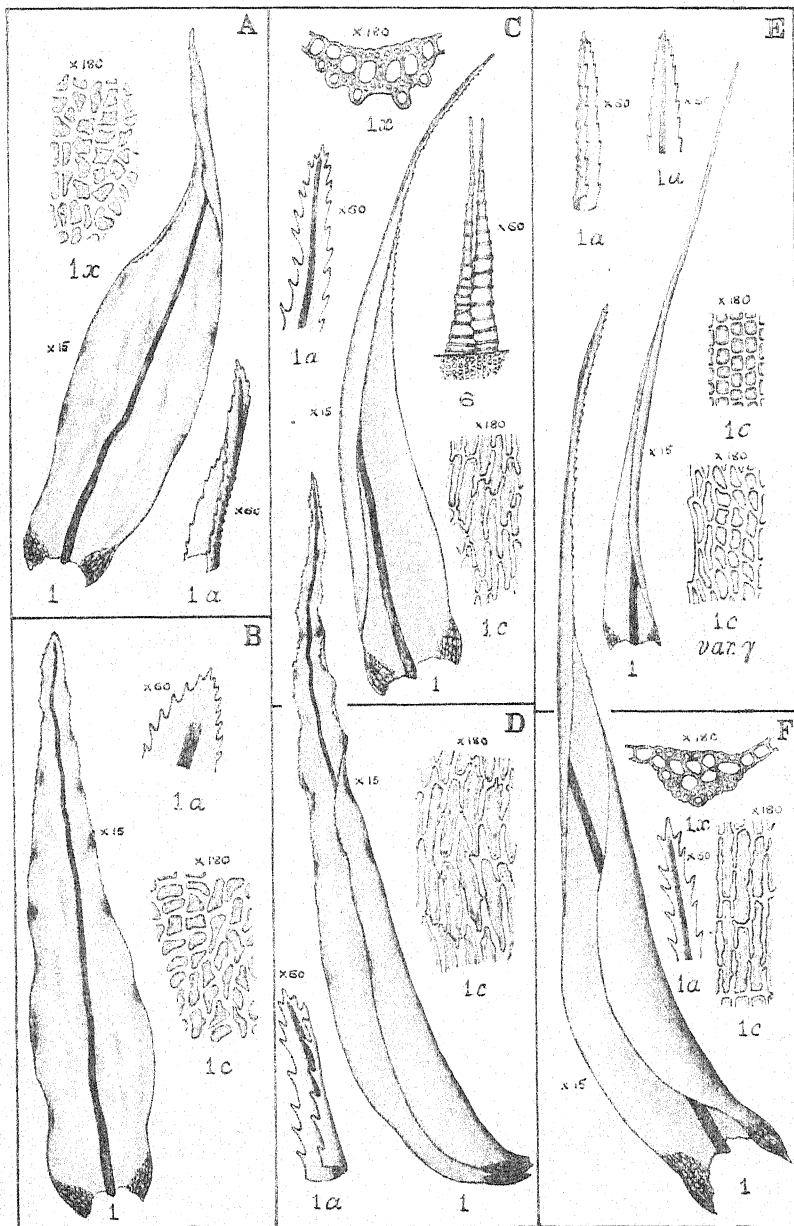


PLATE XLV.

PLATE 46. *A-F*, from Dixon, Handbk. Brit. Mosses, by permission. 1, leaf; 2, branch leaf, if different; 5, capsule; 6, peristome; *, plant or at least a portion of it; *a*, apex; *b*, base; *c*, cells at $\frac{1}{8}$ from apex; *x*, section.

G. Dicranum rhabdocarpum from Mem. Am. Acad. 5²: pl. 3. 1, plant, $\times 1$; 6, capsule; 8, perichaetium; 9, 10, leaves; 12, leaf apex.



A. *Dicranum spurium*. B. *D. Bergeri*. C. *D. scoparium*. D. *D. Bonjeani*.
E. *D. fuscescens*. F. *D. maius*.

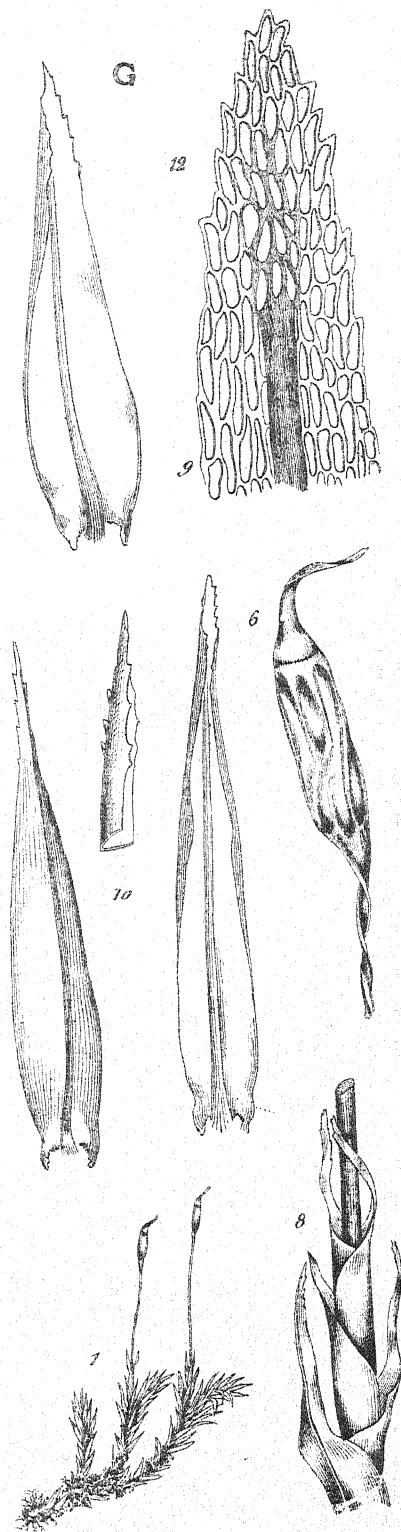


PLATE 47. 1-7 and 12. *Dicranum spadiceum*. 1, leaves from plant from Yellowstone Park, $\times 20$; 2, leaves from plants collected by Holzinger & Blake; 4 and 5, leaf apices of the same, $\times 400$; 6, median leaf cells, $\times 400$; 7, upper cells, $\times 266$; 12, basal cells, $\times 400$.

8-11. *Dicranum laevidens*. 8, leaves, $\times 20$; 9, basal leaf cells, $\times 400$; 10, median leaf cells, $\times 400$; 11, apical cells, $\times 466$.

13-16. *Dicranum groenlandicum*. 13, leaves, $\times 20$; 14, basal leaf cells, $\times 400$; 15, median leaf cells, $\times 400$; 16, leaf apex, $\times 400$ (the apex is typically much more obtuse).

17-20. *Dicranum fragilifolium*. 17, leaves, $\times 13$; 18, basal leaf cells, $\times 233$; 20, lower median leaf cells, $\times 233$, pitted; 19, upper lamina cells, $\times 233$. (All by Seville Flowers).

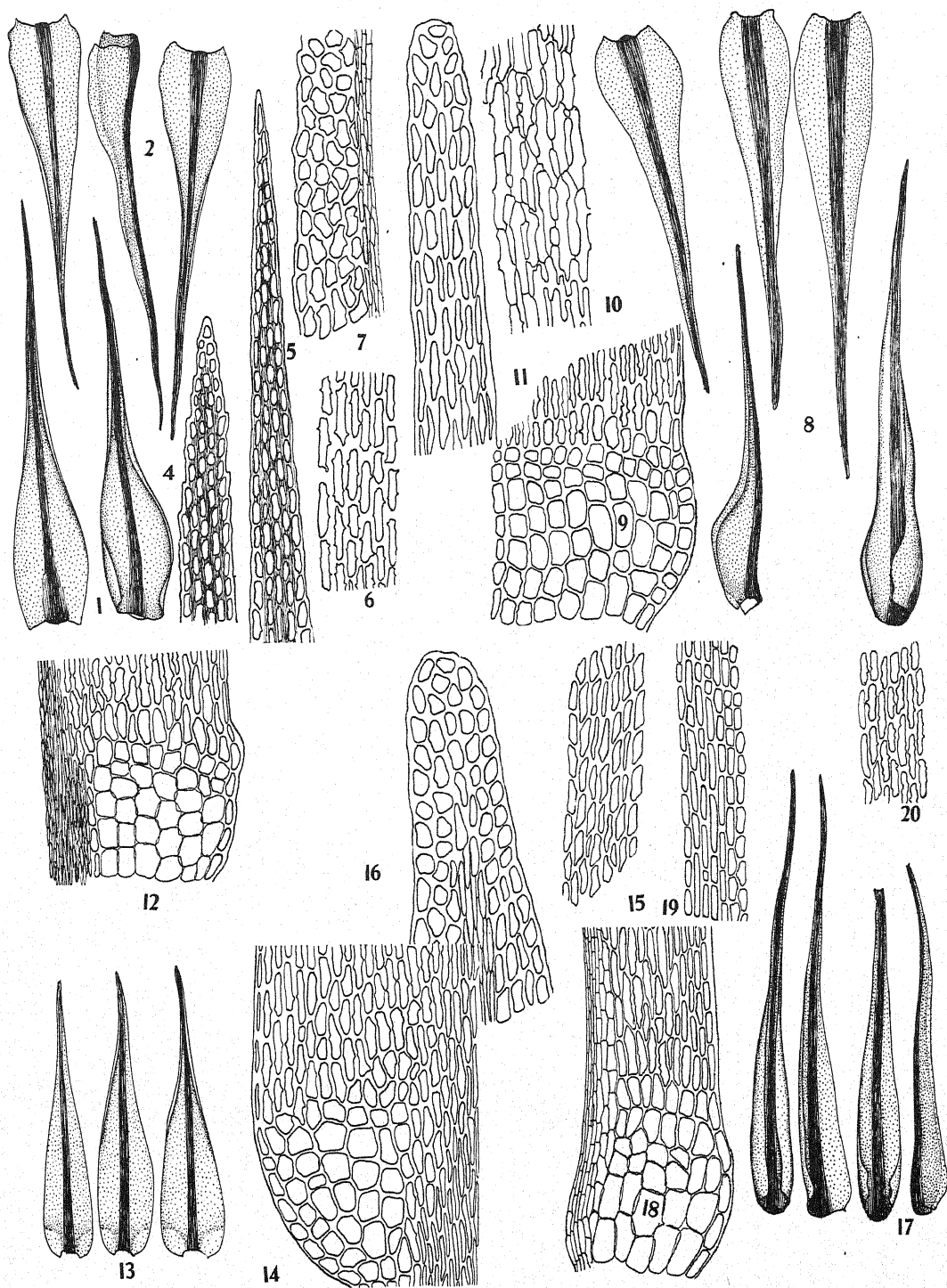
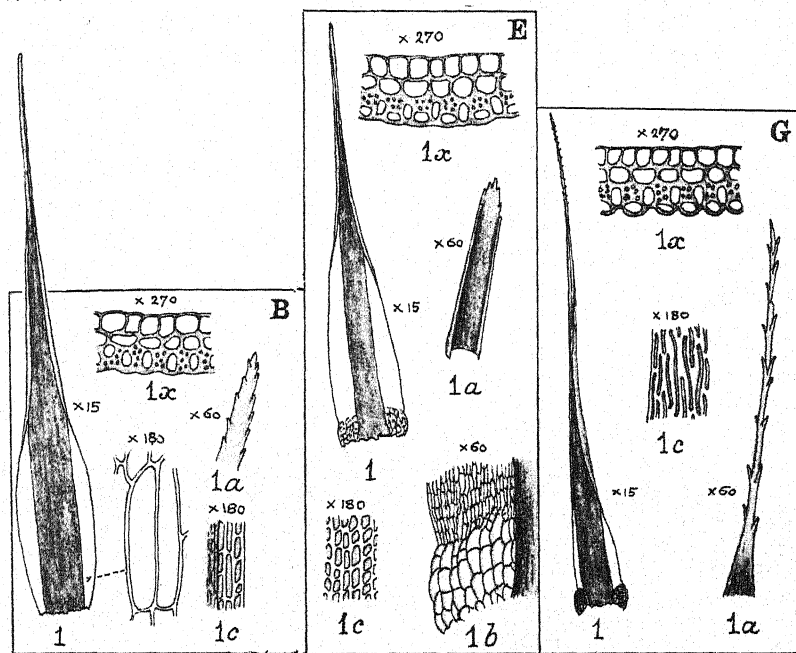
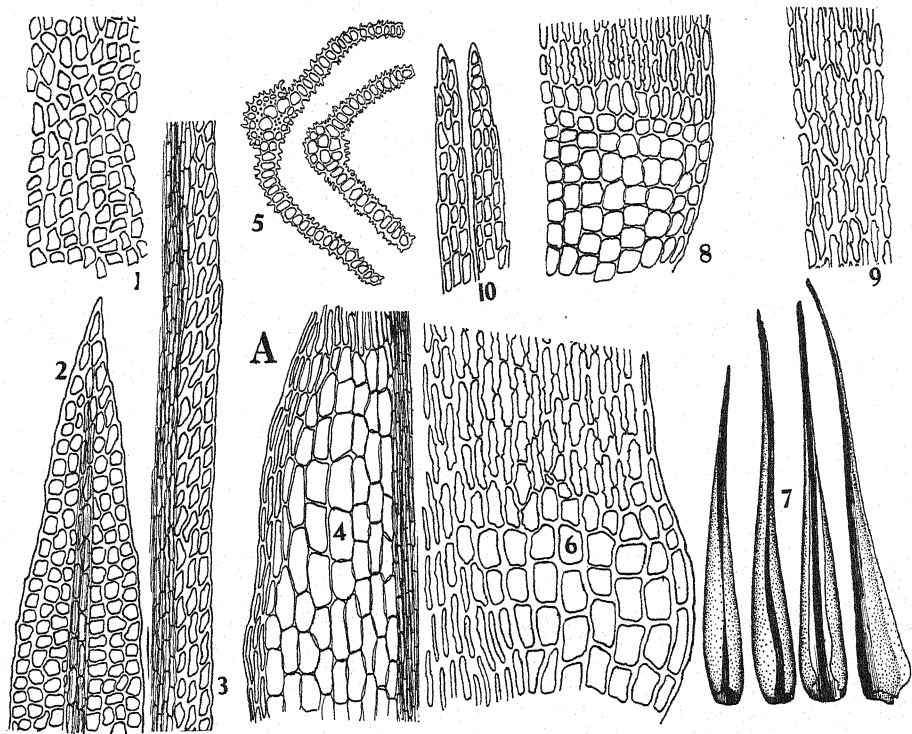


PLATE XLVII

PLATE 48. A. 1, upper median leaf cells of *Dicranum Drummondii*, $\times 400$; 2, leaf apex of *Rhabdoweisia denticulata americana*, $\times 200$; 3 median marginal cells of *Campylopus fragilis*, $\times 400$ (R. & C. Musc. Eur. 361); 4, basal cells of the same, $\times 400$; 5, cross sections of leaf of *Dichodontium olympicum*, $\times 133$; 6, basal leaf cells of *Dicranum elongatum*, $\times 400$; 7-10, *Dicranum angustum* (from Sweden); 7, leaves, $\times 13$; 8, basal cells, $\times 400$; 9, median leaf cells, $\times 400$; 10, leaf apices, $\times 400$. (By Seville Flowers).

B. *B. Campylopus fragilis*; *E. C. atrovirens*; *G. C. flexuosus*, from Dixon, Handbk. Brit. Mosses, pl. 12 (for description see under pl. 46).



B. *C. fragilis*.

E. *C. flexuosus*.

G. *C. atrovirens*.

PLATE 49. Figs 1-3, *Campylopus tallulensis subleucogaster*. 1, leaves, $\times 20$; 2, basal leaf cells, $\times 400$; 3, upper median leaf cells, $\times 400$. (1 not numbered).

4-7, *Campylopus angustiretis*. 4, leaves, $\times 20$; 5, basal leaf cells, $\times 400$; 6, median leaf cells, $\times 400$; 7, leaf apex, $\times 400$.

8-18, *Campylopus gracilicaulis*. 8, plants, $\times \frac{2}{3}$ (often more tufted at the top than shown); 9, stem leaves of the type; 10, comal leaves of a Florida plant; 11, 12, 13, basal, median and upper median leaf cells respectively, $\times 400$; 14, leaf apex, $\times 400$; 15, fruiting plant, $\times 3$; 16, seta and capsule, $\times 20$; 17, calyptra, $\times 13$; 18, peristome, $\times 200$ (By Seville Flowers).

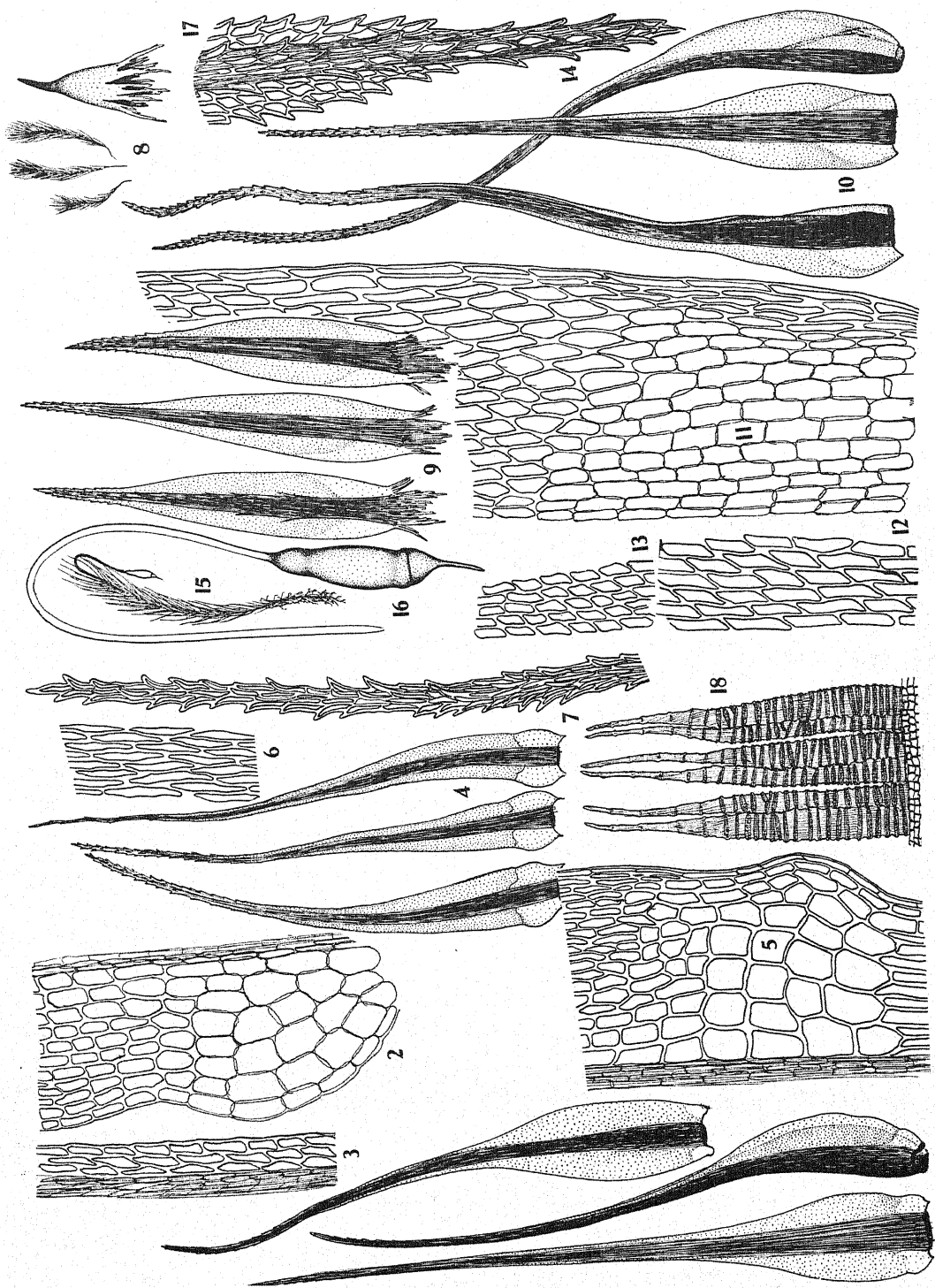


PLATE 50. A. *Campylopus tallulensis* (from Sull. Icones *pl.* 17). 1, plants, $\times 1$; 2, enlarged; 3, 4, leaves; 6-9, cross sections of leaf from near apex to base; 5, areolation of leaf base; 10, of leaf apex.

B. *Brothera leana* (from Sull. Icones Musc. *pl.* 18). 1, plants natural size; 2, 3, the same much enlarged; 4, 5, 6, leaves; 7 and 8, cells of leaf apex and base respectively; 9, cross sections of leaf; 10, 11, branched upper stem showing attachment of rudimentary leaves which probably act as brood bodies; 12, these last enlarged still more.

C. *Dicranum Drummondii* (from Sull. Icones Musc. Suppl. *pl.* 33). 1, plants, $\times 1$, both wet and dry; 2, leaves; 3, cell structure of leaf apex; 6, operculate capsule.



PLATE L.

PLATE 51. A. *Paraleucobryum Sauteri* (from Bry. Eur. *pl.* 71). 4, 5, leaves; 5*a*, 5*b*, areolation of leaf apex and base; 6, male bud; 8, 9, inner perigonal leaves; 11, perichaetium; 16, dry and empty capsule; 17, 18, 19, peristome teeth.

B. *Paraleucobryum enerve* (from Bry. Eur. *pl.* 73). 6, leaves; 4*a*, 4*b*, leaf apex and base showing structure; 8, branch with abortive perichaetia; 9-12, leaves of the same; 13, perichaetium; 23, annulus; 24, portion of mouth of capsule with peristome teeth.

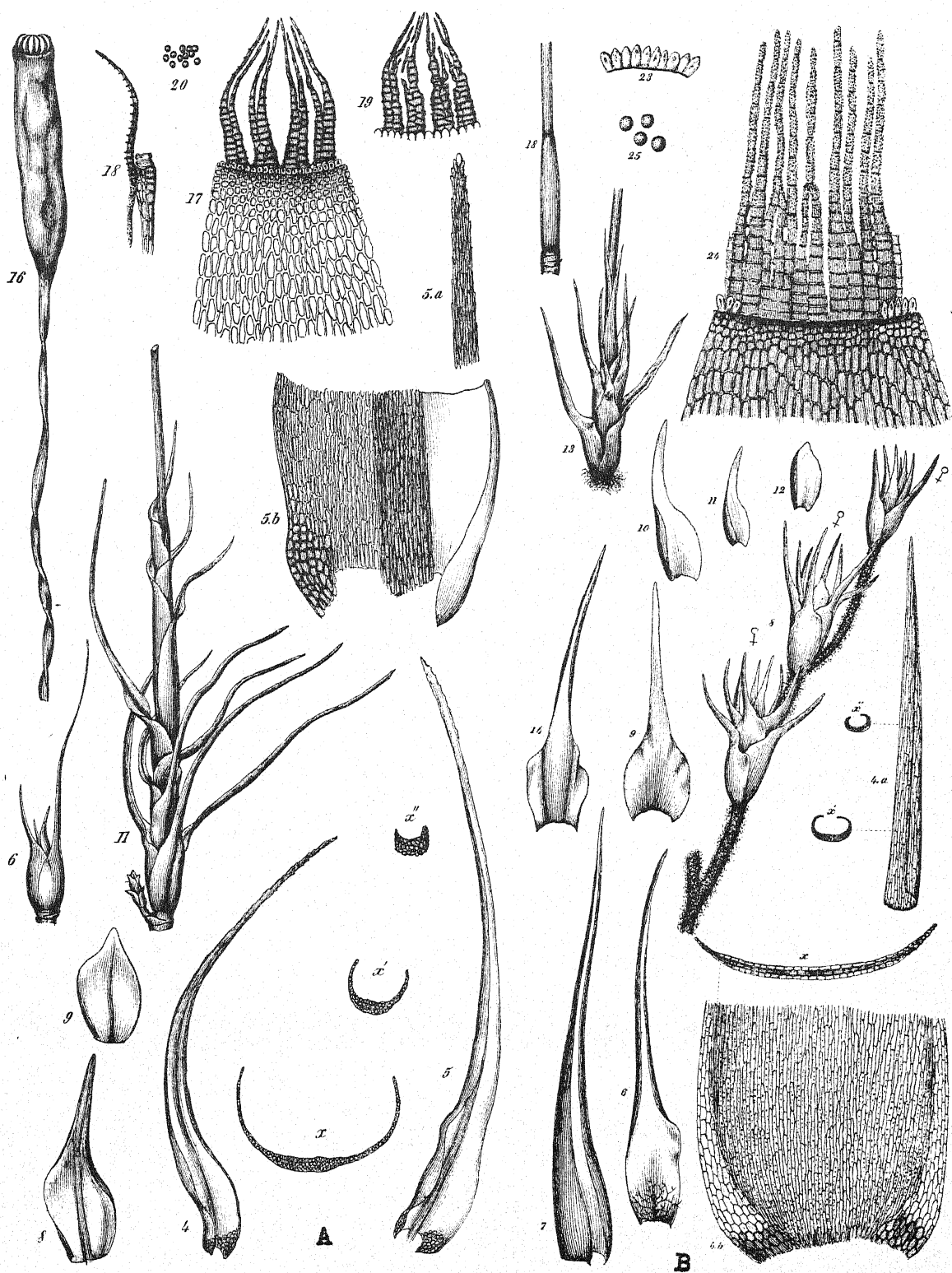


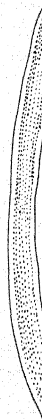
PLATE LI.

PLATE 52. 1-5, *Octoblepharum albidum*. 1, plant, $\times 2$; 2, leaves, $\times 25$; 3, cross section of leaf, $\times 125$; 4, capsules, $\times 17$; 5, peristome teeth, $\times 250$.

6-11, *Leucobryum albidum*. 6, moist plants, $\times 2$; 7, dry plant, $\times 2$; 8, leaves, $\times 25$; 9, cross sections of leaf, $\times 125$; 10, capsules, $\times 17$; 11, peristome tooth, $\times 125$.

12-14, *Leucobryum glaucum*. 12, dry plant, $\times 4$; 13, leaves, $\times 25$; 14, partial section of leaf near base, $\times 125$. (Magnification of 14 doubtful.)

15-18, *Leucobryum antillarum*. 15, small plant dry, $\times 2$; 16, leaves, $\times 25$; 17, cross sections of leaf, $\times 125$. (All drawings by Seville Flowers.)



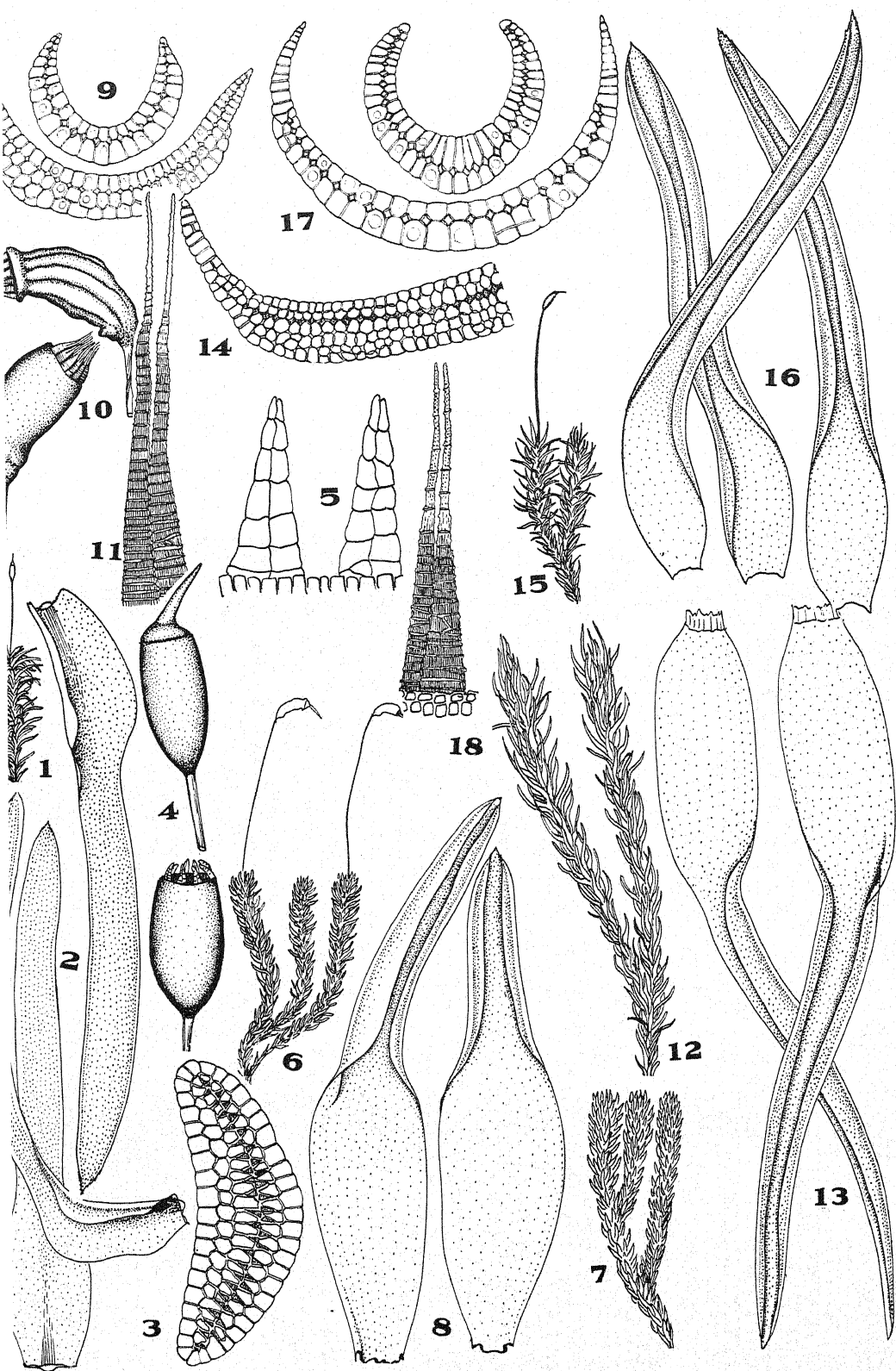


PLATE LII.

PLATE 53. A. *Atrichum crispum* (1-7, 9-10 from Proc. Wash. Acad. Sci. 12: 277. f. 1.). 1, leaf, $\times 11$; 2, moist plant with capsule, $\times 1$; 3, capsule with lid, $\times 4$; 4, plant dry, showing crisping of leaves, $\times 1$; 5, leaf tip, $\times 49$; 6, cross section of leaf margin showing thickened border cells, $\times 208$; 7, cross section of leaf showing lamellae, $\times 49$; 8, marginal cells about $\frac{2}{3}$ up leaf, $\times 144$; 9, peristome, $\times 103$; 10, cross section of a few lamellae, $\times 208$; 11, cross section of a few lamellae of var. *molle*, $\times 250$; 12, leaf tip of var. *molle* twisted to show marginal cells of leaf and teeth on back of costa, $\times 57$; 13, cells of lamella of var. *molle*, $\times 250$.

B. *Atrichum undulatum* (14-16 after Jennings; 2, 4-8, 10-12, from Proc. Wash. Acad. Sci. 12: 279 f. 3; 9, 18-19 from Proc. Wash. Acad. Sci. 12: 280. f. 4 as *Catharinea Selwyni*). 1, cells of lamella, $\times 250$; 2, leaf tip, $\times 49$; 3, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$; 4, cross section of leaf, $\times 49$; 5, cross section of a few lamellae, $\times 208$; 6, cross section of leaf margin showing thickened border cells, $\times 208$; 7, moist plant with capsule, $\times 1$; 8, capsule with lid, $\times 3.5$; 9, capsule shownig peristome, $\times 3.5$; 10, dry antheridial plant with (δ) antheridial disk through which stem has continued, $\times 1$; 11, leaf, $\times 14$; 12, peristome, $\times 117$; 13, moist plant with capsules of var. *Hausknechtii*, $\times 1$; 14, plant with capsule of var. *minor*, $\times 1$; 15, leaf of var. *minor*, $\times 5$; 16, cross section of leaf of var. *minor*, $\times 75$; 17, cells of lamella of var. *minor*, $\times 150$; 18, cross section of leaf of var. *Selwyni*, $\times 49$; 19, cross section of a few lamellae of var. *Selwyni*, $\times 183$.

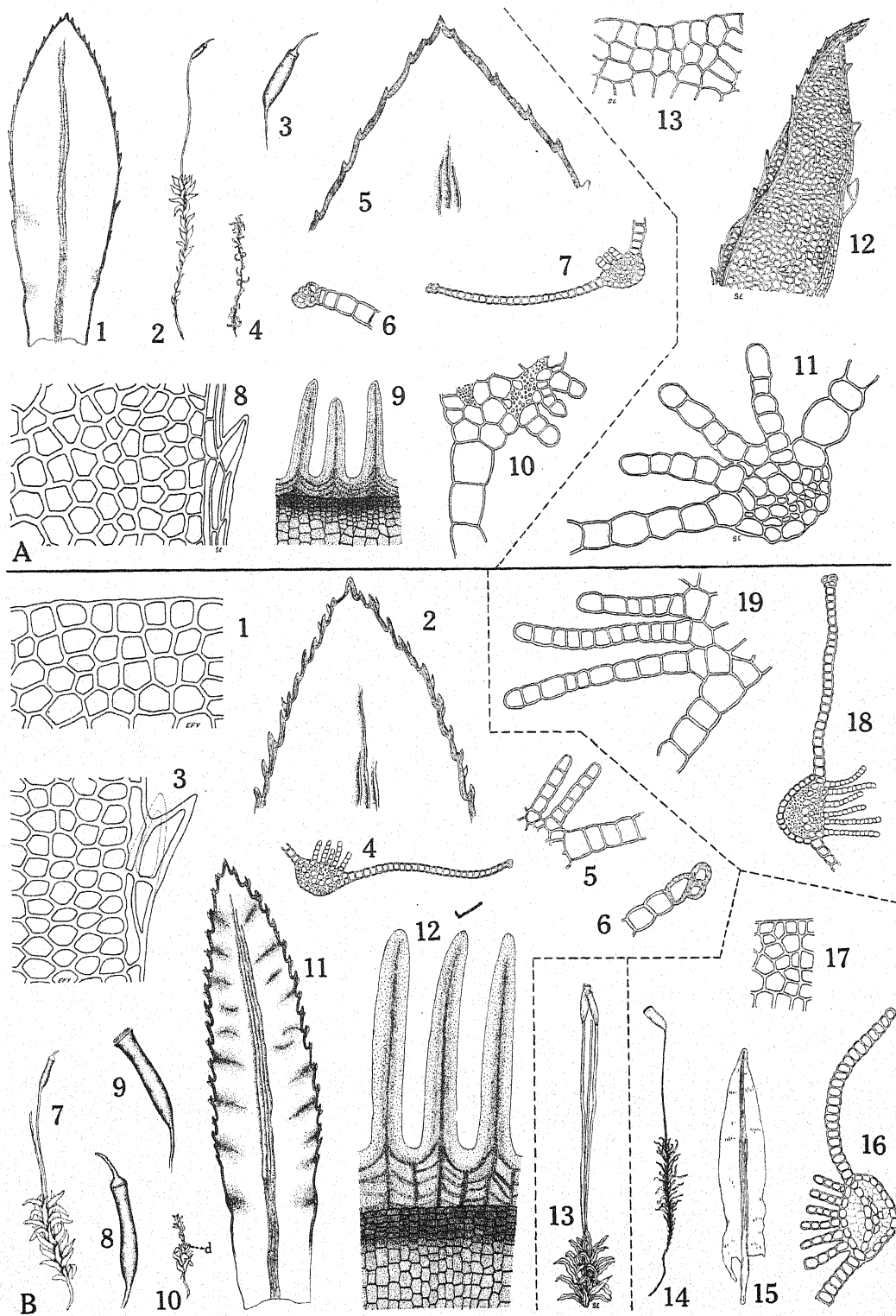


PLATE LIII.

PLATE 54. A. *Atrichum angustatum* (8, 19 from Proc. Wash. Acad. Sci. 12: 278. f. 2; 22-24 after Jennings). 1, capsule showing peristome, $\times 7$; 2, capsule and bract, $\times 2$; 3, moist plant, $\times 0.67$; 4, dry plant, $\times 3.3$; 5, calyptra, $\times 29$; 6, hair of the calyptra, $\times 655$; 7, lid of capsule, $\times 35$; 8, capsule with lid, $\times 4$; 9, cells of lamella, $\times 250$; 10, marginal cells of the leaf, $\times 250$; 11, leaf tip from back, $\times 150$; 12, teeth of the peristome, $\times 218$; 13, leaf of female branch, back view, $\times 4$; 14, leaf of female branch, front view, $\times 4$; 15, basal marginal cells of leaf, $\times 147$; 16, cross section of leaf, $\times 108$; 17, inner perichaetial leaf, front view, $\times 12$; 18, leaf cells about $\frac{3}{4}$ of the way between costa and border, $\times 132$; 19, cross section of a few lamellae, $\times 167$; 20, cross section of leaf margin showing thickened border cells, $\times 193.3$; 21, cross section of leaf, $\times 43.3$; 22, leaf of var. *plurilamellatum*, $\times 8$; 23, cross section of leaf of var. *plurilamellatum*, $\times 80$; 24, moist plant of var. *plurilamellatum* with capsule, $\times 1$.

B. *Atrichum papillosum* (1-3, 5 after Jennings). 1, moist plant with capsule, $\times 1$; 2, leaf, $\times 10$; 3, teeth of peristome, $\times 55$; 4, capsule showing peristome, $\times 4$; 5, lower marginal cells of the leaf, $\times 267$; 6, cross section of leaf showing a few lamellae, $\times 307$.

C. *Atrichum Macmillani* (4-8 from Rhodora 9: pl. 74). 1, moist plant with capsule, $\times 2.3$; 2, dry plant, $\times 1.7$; 3, leaf, $\times 8$; 4, outline of median cross section of leaf, $\times 50$; 5, detail of same cross section, $\times 150$; 6, basal marginal cells of median leaf, $\times 150$; 7, upper marginal cells of median leaf, $\times 150$; 8, teeth of peristome, $\times 198$.

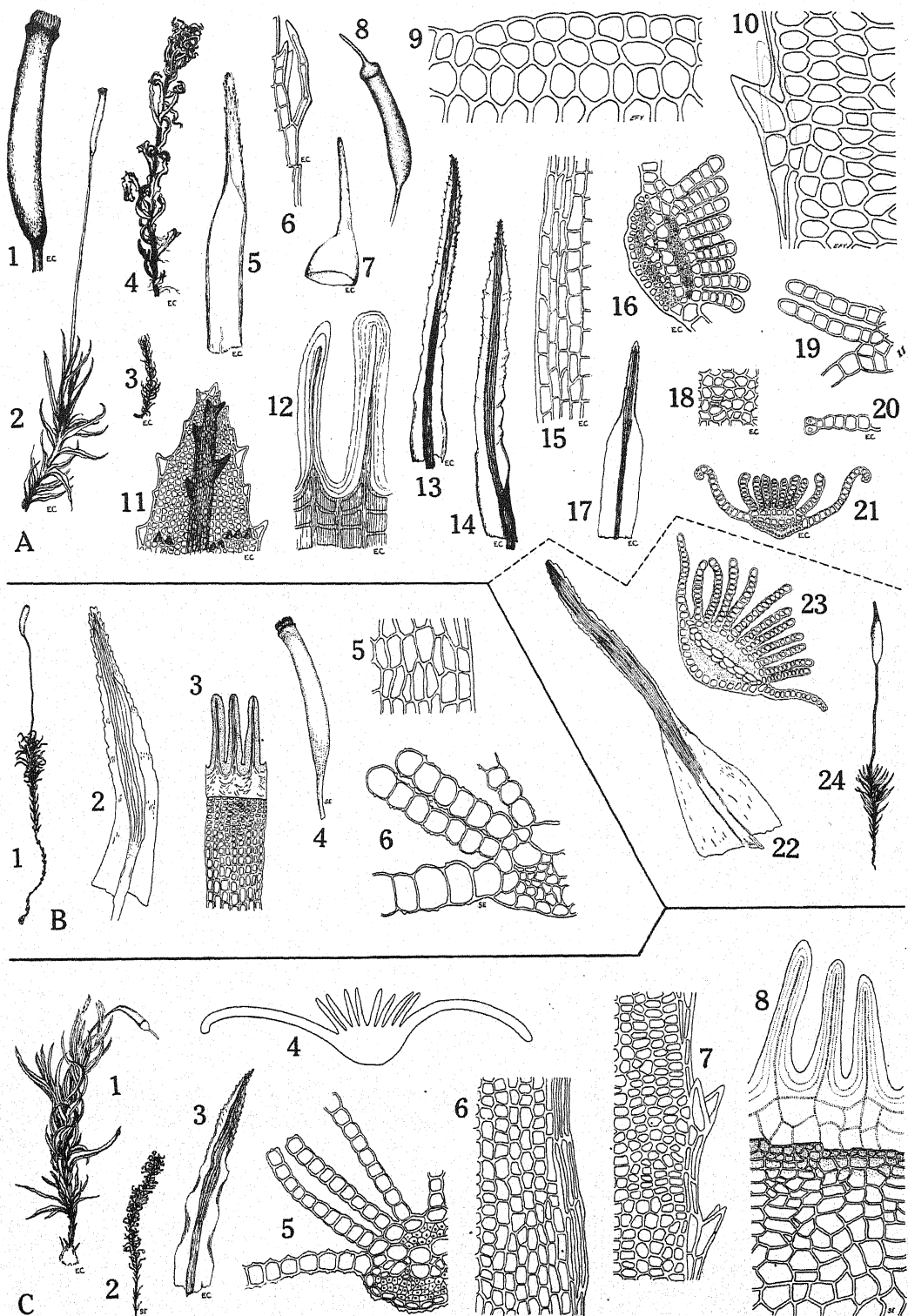


PLATE LIV.

PLATE 55. A. *Oligotrichum parallelum* (3-11 from Proc. Wash. Acad. Sci. 12: 283. f. 5). 1, side view of lamella, the upper edge the margin, $\times 184$; 2, leaf cells at about $\frac{3}{4}$ up, $\times 184$; 3, ventral view of leaf tip, $\times 58$; 4, moist plant, $\times 0.9$; 5, dry plant, d , the location of the antheridial cup, $\times 0.9$; 6, capsule, $\times 4.5$; 7, ventral view of leaf, $\times 13.5$; 8, dorsal view of leaf, $\times 13.5$; 9, peristome, $\times 135$; 10, cross section of a few lamellae, $\times 225$; 11, cross section of leaf at about $\frac{2}{3}$ up, $\times 58$.

B. *Oligotrichum hercynicum* (1, 3-9, 11, 13-15 from Proc. Wash. Acad. Sci. 12: 285. f. 7 as *O. incurvum*; 10, 12 from Bryol. Eur. pl. 413). 1, plant dry, $\times 0.9$; 2, side view of ventral lamella, $\times 184$; 3, dorsal view of leaf almost entire, $\times 13.5$; 4, ventral view of leaf with dorsal lamellae and crests on lamina, $\times 13.5$; 5, cross section of a few lamellae, $\times 225$; 6, ventral view of leaf with entire margins, $\times 13.5$; 7, leaf tip, entire, with distinct dorsal lamellae, $\times 58$; 8, leaf tip, serrate, with low dorsal lamellae, $\times 58$; 9, plant moist, $\times 0.9$; 10, calyptra, $\times 9.6$; 11, capsule, $\times 4.5$; 12, lid, $\times 12$; 13, cross section of leaf about $\frac{2}{3}$ up, $\times 58$; 14, peristome, $\times 135$; 15, marginal leaf cells at $\frac{3}{4}$, $\times 450$.

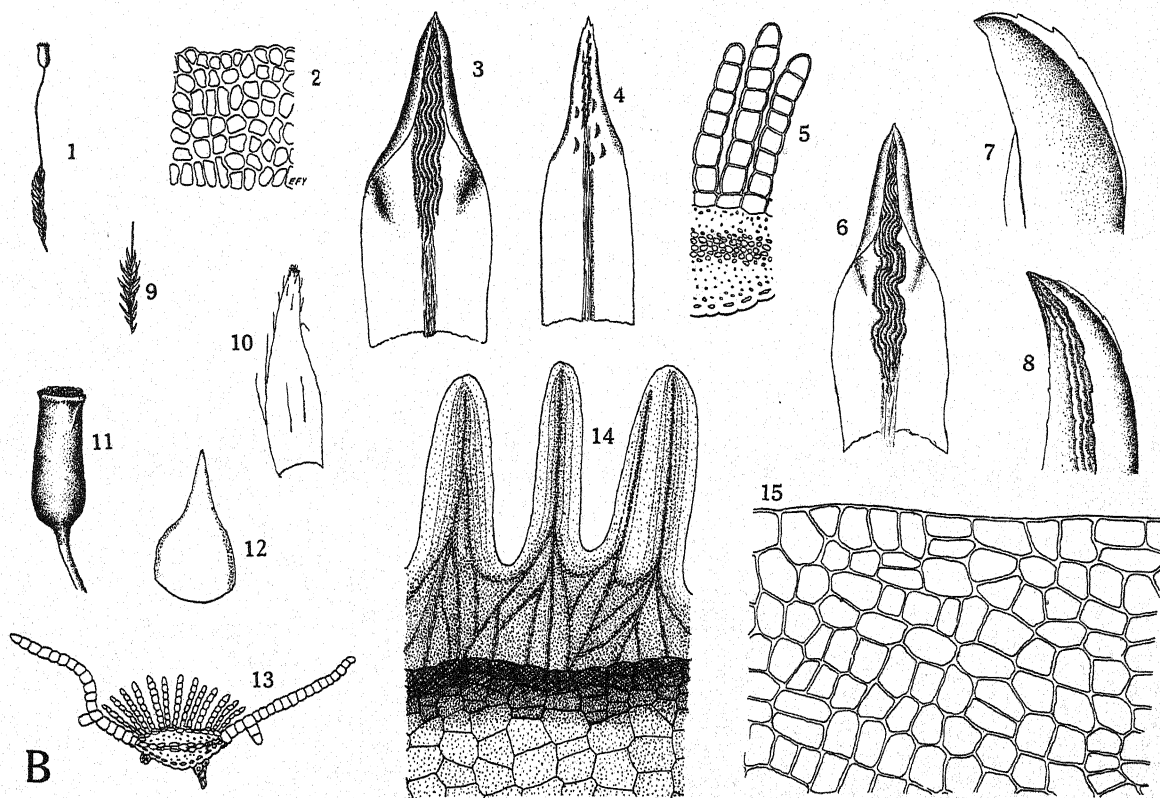
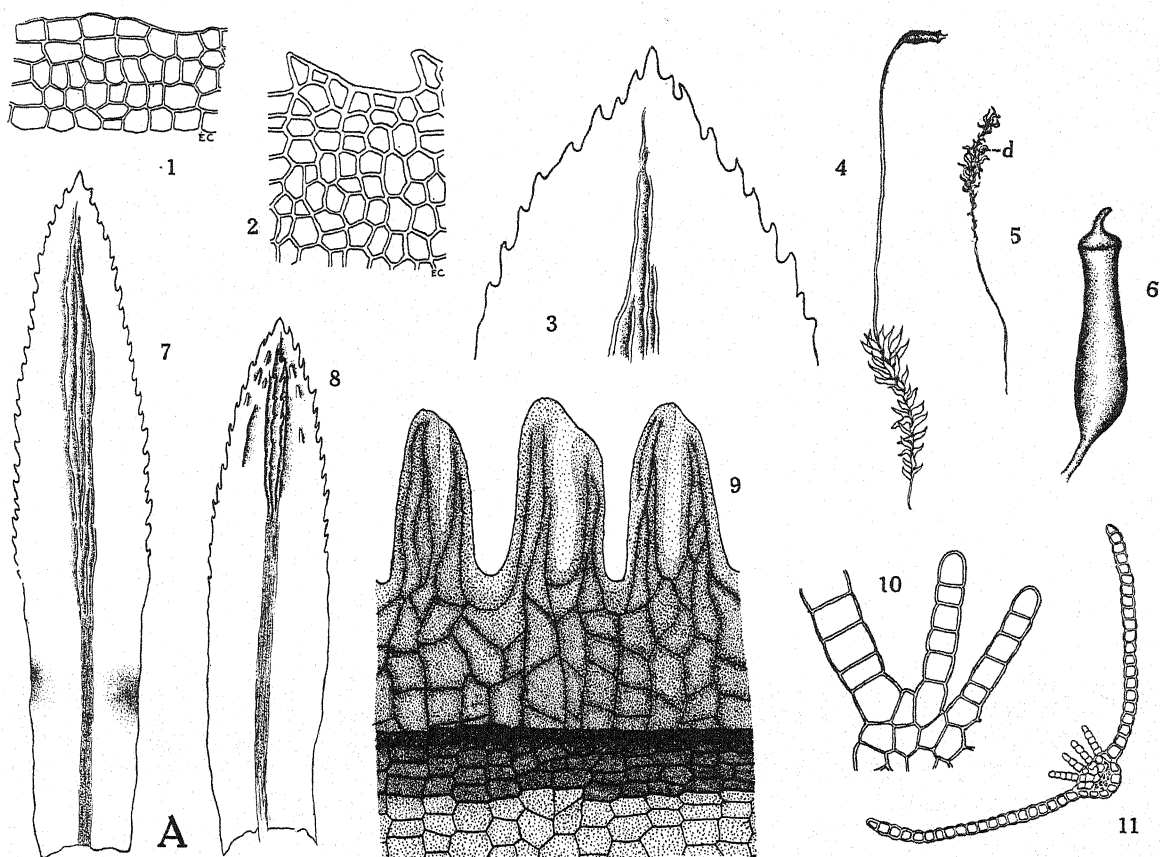


PLATE LV.

PLATE 56. A. *Oligotrichum aligerum* (3-9 from Proc. Wash. Acad. Sci. 12: 284. f. 6). 1, leaf margin at about $\frac{3}{4}$ up, $\times 400$; 2, side view of lamella, the upper edge the margin, $\times 400$; 3, moist plant, about $\times 1$; 4, leafy part of moist plant, *d*, antheridial bracts, about $\times 1$; 5, hair of calyptra; 6, capsule, about $\times 100$; 7, calyptra; 8, cross section of leaf at about $\frac{3}{4}$ up, *m*, leaf margin, about $\times 25$; 9, peristome, about $\times 140$; 10, leaf tip, $\times 50$; 11, ventral view of leaf, $\times 28$.

B. *Oligotrichum laevigatum* (4-9, 11 from Proc. Wash. Acad. Sci. 12: 289. f. 9 as *Psilopilum glabratum*; 12-14 from Proc. Wash. Acad. Sci. 12: 287. f. 8a as *Oligotrichum incurvum* var. *latifolium*). 1, side view of lamella, the upper edge the margin, $\times 230$; 2, margin of leaf at about $\frac{2}{3}$ up showing characteristic diagonal walls, $\times 400$; 3, leaf tip, ventral view, $\times 91$; 4, ventral side of leaf, $\times 17$; 5, moist plant, $\times 1.1$; 6, dry plant, $\times 1.1$; 7, cross section of a few lamellae, $\times 281$; 8, peristome, $\times 169$; 9, mature capsule, $\times 5.6$; 10, calyptra, $\times 12.5$; 11, cross section of leaf, $\times 74$; 12, ventral view of leaf of var. *cavifolium*, $\times 7.5$; 13, side view of leaf tip of var. *cavifolium*, $\times 32.5$; 14, cells of leaf margin of var. *cavifolium* at about $\frac{3}{4}$ up, $\times 250$.

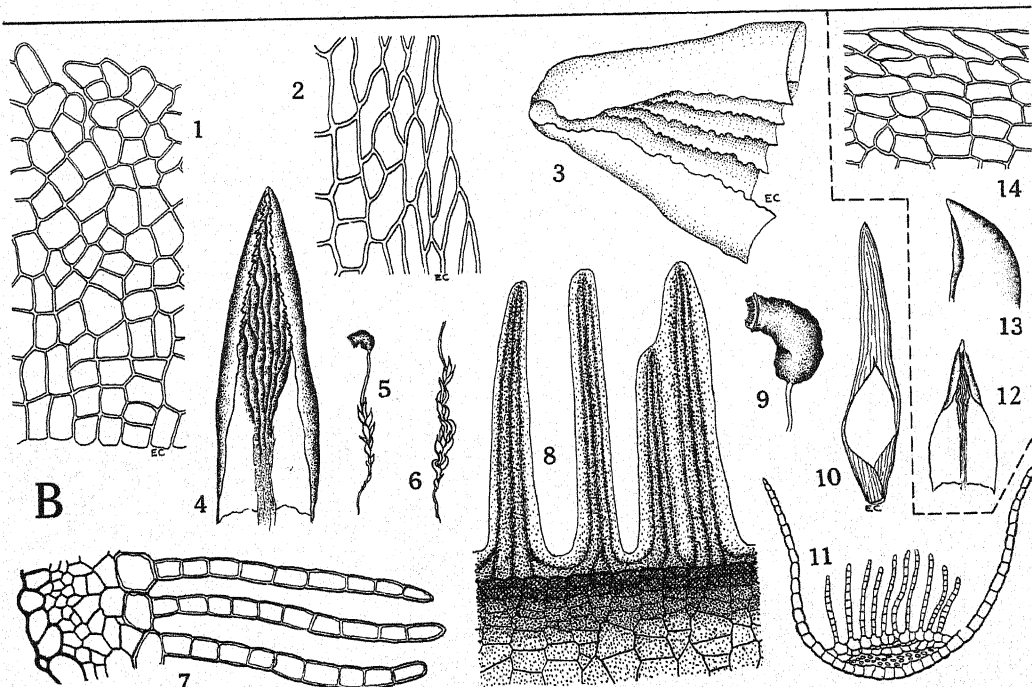
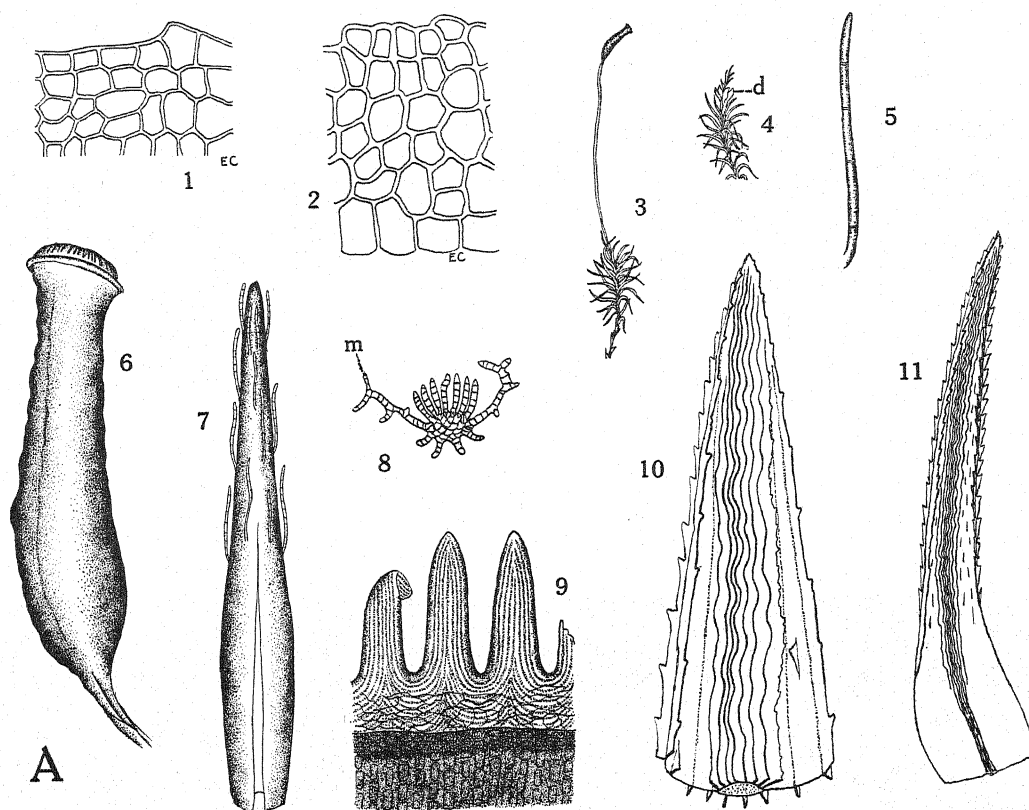


PLATE LVI.

PLATE 57. A. *Lyellia Lescurii* (1-5, 7, 9-11 from Proc. Wash. Acad. Sci. 12: 291. f. 10 as *Bartramiopsis Lescurii*). 1, dry plant, $\times 1$; 2, moist plant with capsule, $\times 1$; 3, leaf, upper side, $\times 18$; 4, back of leaf, $\times 13.5$; 5, leaf tip, $\times 125$; 6, marginal cilium of leaf, $\times 230$; 7, mature capsule, $\times 10$; 8, calyptra, about $\times 10$; 9, capsule dried and rather young, showing lid, $\times 6.2$; 10, cross section of a few lamellae, $\times 312$; 11, cross section of leaf, $\times 81$; 12, side view of lamella, the upper edge the margin, $\times 400$.

B. *Lyellia aspera* (from Medd. om Groenland 15: 390. f. 1-9, as *Philocrya aspera*). 1, leaf, upper side, $\times 10$; 2, leaf tip seen from side, $\times 55$; 3, leaf tip, $\times 30$; 4, cross section of margin of leaf at about $\frac{1}{8}$ up, $\times 260$; 5, cross section of leaf near tip, $\times 55$; 6, side view of lamella, the upper edge the margin, $\times 260$; 7, median cross section of leaf, $\times 30$; 8, cross section showing the lamellae, $\times 130$; 9, median cross section of the leaf margin, $\times 260$.

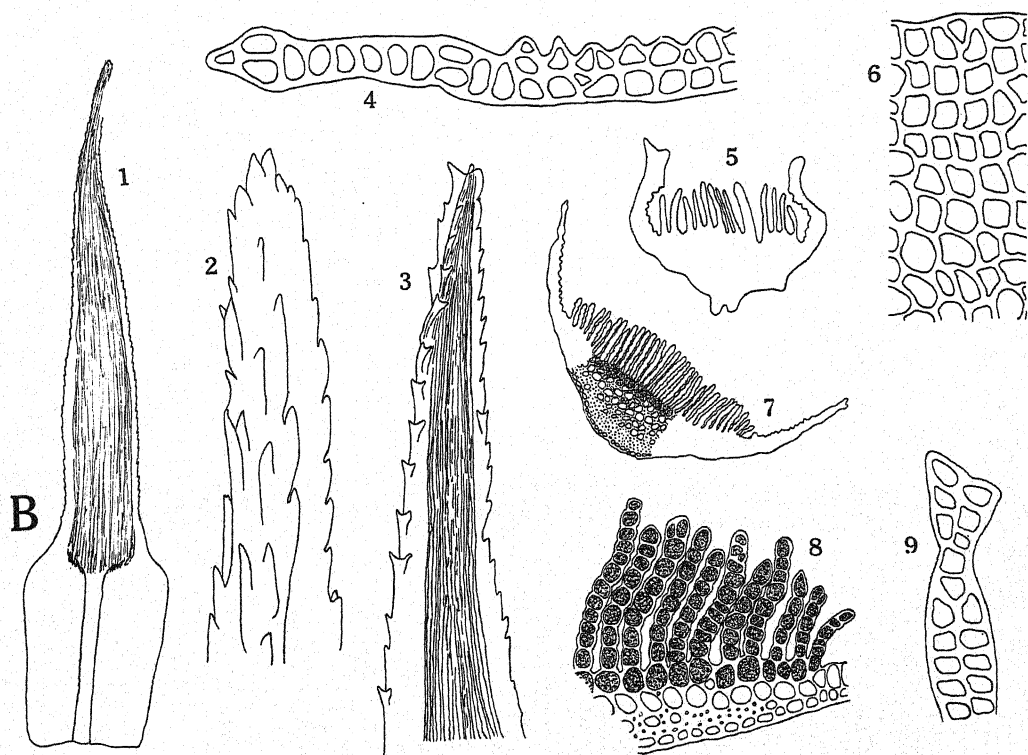
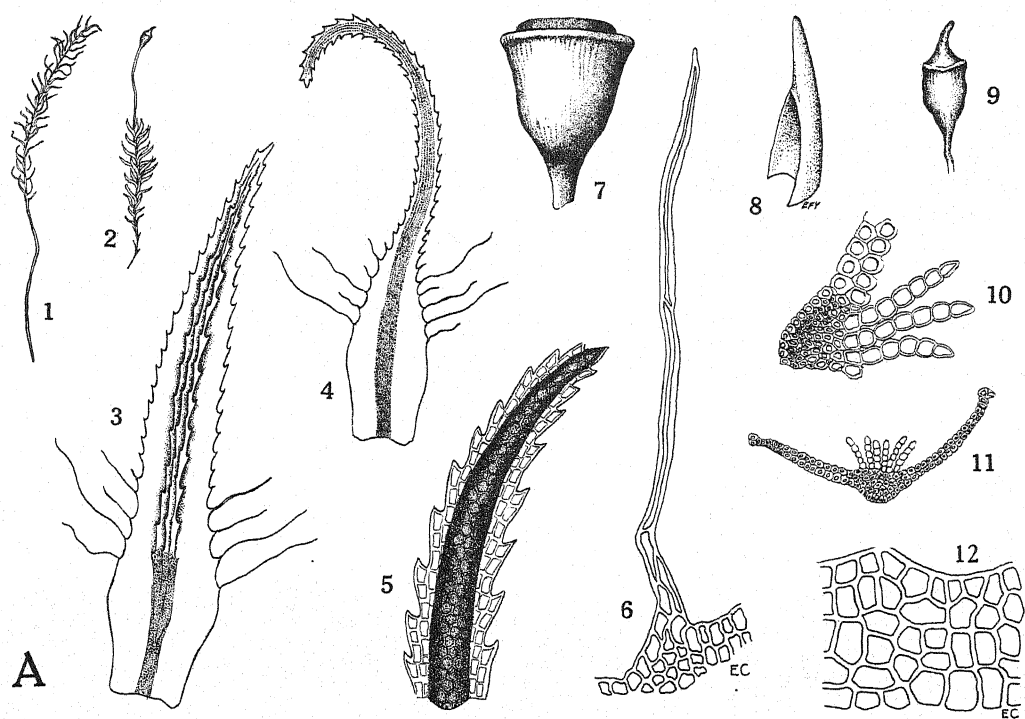


PLATE LVII.

PLATE 58. A. *Polytrichadelphus Lyallii* (1-9, 11, 14-16 from Proc. Wash. Acad. Sci. 12: 293. f. 11; 12-13 from Bryol. 35: pl. 4). 1, moist plant with capsules, $\times 0.8$; 2, dry plant, $\times 0.8$; 3, cross section of capsule near mouth, $\times 7$; 4, cross section of capsule near base, $\times 7$; 5, capsule, showing double fold; 6, capsule, $\times 4$; 7, leaf tip, $\times 45$; 8, cross section of a few lamellae, $\times 180$; 9, hair of calyptra; 10, side view of lamella, $\times 250$; 11, cross section of leaf, $\times 33$; 12, calyptra with few hairs, $\times 8$; 13, calyptra, quite hairy, $\times 8$; 14, peristome, about $\times 75$; 15, 16, leaves, $\times 12$; 17, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$.

B. *Pogonatum pensilvanicum* (1, 3, 6, 8 after Jennings). 1, central margin of leaf, $\times 267$; 2, side view of lamella, $\times 250$; 3, lower margin of leaf, $\times 267$; 4, moist plant with capsule, $\times 3$; 5, upper margin of leaf, $\times 250$; 6, leaf, $\times 12$; 7, capsule with lid, $\times 10$; 8, peristome, about $\times 67$.

C. *Pogonatum brachyphyllum*. 1, moist plant with capsule, $\times 3.3$; 2, moist plant, $\times 2$; 3, calyptra, $\times 8$; 4, side view of lamella, $\times 250$; 5, capsule with lid, $\times 8$; 6, papillosity of epidermis of capsule, $\times 67$; 7, capsule, $\times 4$; 8, margin of leaf at about $\frac{3}{4}$ up, $\times 267$; 9, leaf, $\times 8$; 10, leaf from nearer base of plant, $\times 8$; 11, cross section of margin of leaf, $\times 267$; 12, peristome, $\times 61$; 13, cross section of leaf, $\times 61$.

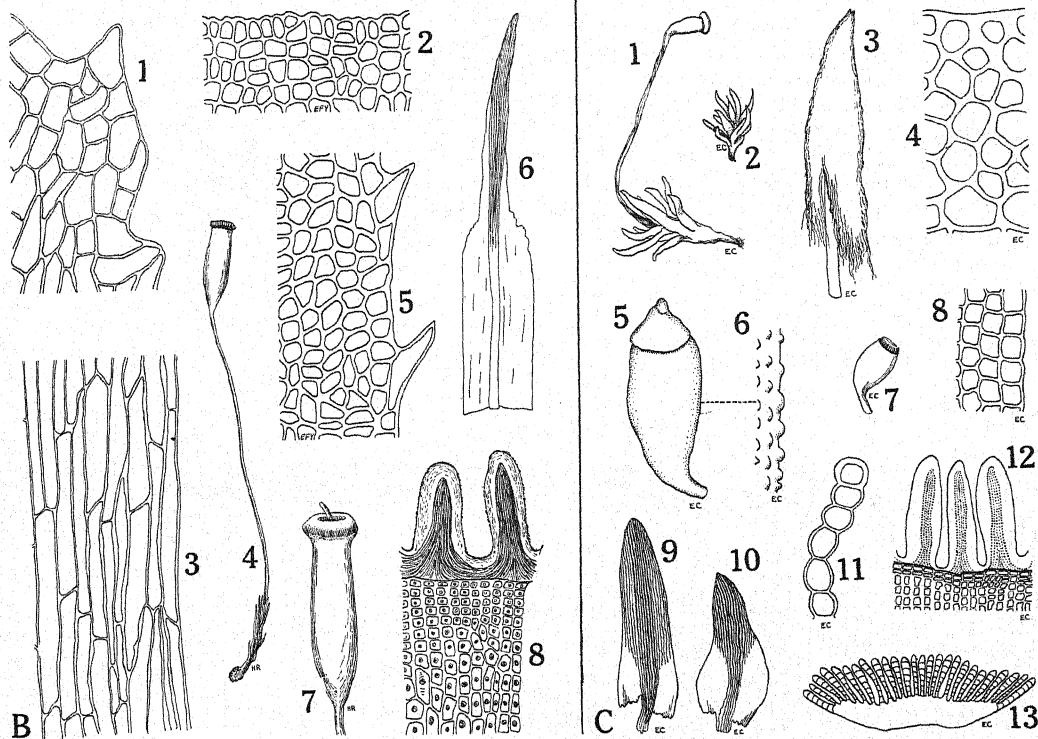
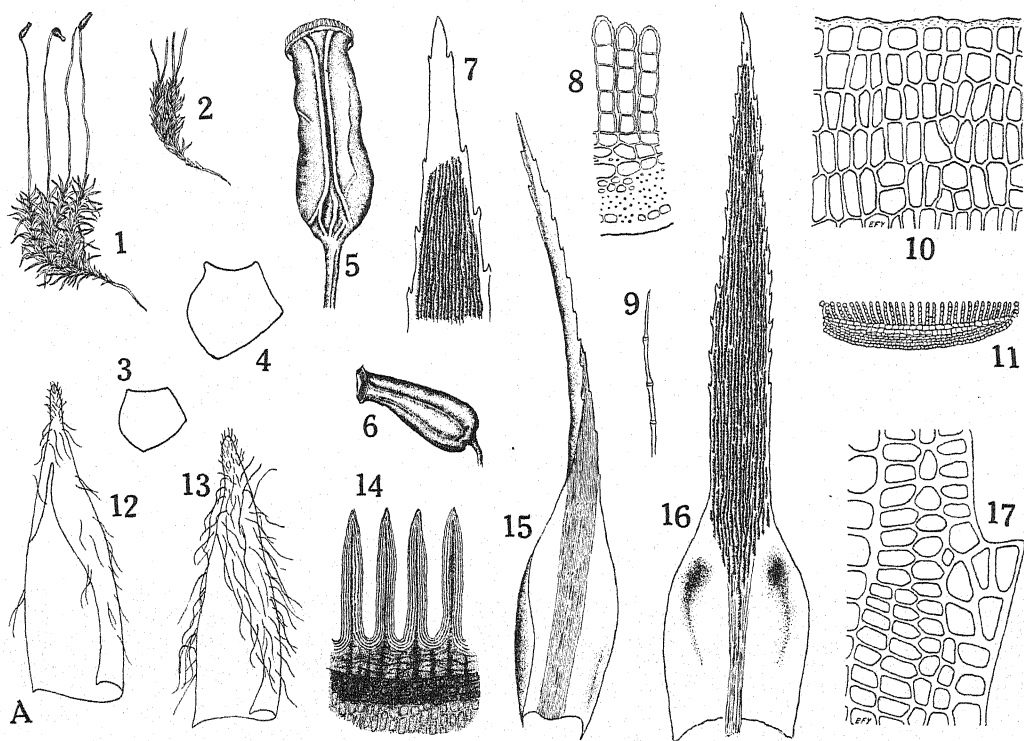


PLATE LVIII.

PLATE 59. A. *Pogonatum contortum* (1-5, 7-10, 12-13 from Proc. Wash. Acad. Sci. 12: 296. f. 12). 1, moist plant with capsule, stem having continued beyond point where pedicel arises, $\times 1$; 2, dry antheridial plant, *d*, antheridial disk through which stems have grown, $\times 1$; 3, 4, capsules, $\times 4$; 5, immature capsule covered by calyptra, $\times 4$; 6, side view of lamella, the upper edge the margin, $\times 250$; 7, leaf tip, $\times 45$; 8, cross section of leaf margin, $\times 167$; 9, cross section of leaf, $\times 45$; 10, cross section of a few lamellae, $\times 167$; 11, marginal cells of leaf at about $\frac{3}{8}$ up, $\times 250$; 12, peristome, $\times 117$; 13, leaf, showing lamellae on upper side, $\times 12$.

B. *Pogonatum urnigerum* (2, 4-11 from Proc. Wash. Acad. Sci. 12: 300. f. 14). 1, marginal cells of leaf at about $\frac{3}{8}$ up, $\times 250$; 2, leaf tip, $\times 49$; 3, side view of lamella, showing marginal papillosity, $\times 250$; 4, cross section of leaf, $\times 49$; 5, cross section of a few lamellae, showing rounded, thick walled papillose marginal cells, $\times 171$; 6, peristome, $\times 93$; 7, capsule with lid, $\times 4$; 8, immature capsule covered by calyptra, $\times 0.8$; 9, dry antheridial plant, *d*, old antheridial disk through which young shoot has grown, $\times 0.8$; 10, moist plant with capsule, $\times 0.8$; 11, leaf, showing lamellae on upper side, $\times 12$.

C. *Pogonatum capillare* (1, 4-18 from Proc. Wash. Acad. Sci. 12: 298. f. 13). 1, moist plant with capsules, $\times 0.7$; 2, marginal cells of leaf at about $\frac{3}{8}$ up, $\times 250$; 3, moist plant with capsule, $\times 0.7$; 4, 5, dry antheridial plants, *d*, antheridial disks, $\times 0.7$; 6, side view of lamella, showing marginal papillosity, $\times 250$; 7, cross section of a few lamellae, $\times 180$; 8, 9, cross sections of leaves, $\times 45$; 10, 11, capsules with lid, $\times 4$; 12, 13, immature capsules covered by calyptras, $\times 4$; 14, leaf tip, $\times 45$; 15, leaf, $\times 11$; 16, peristome, $\times 105$; 17, double tooth of peristome, $\times 105$; 18, leaf, $\times 11$.

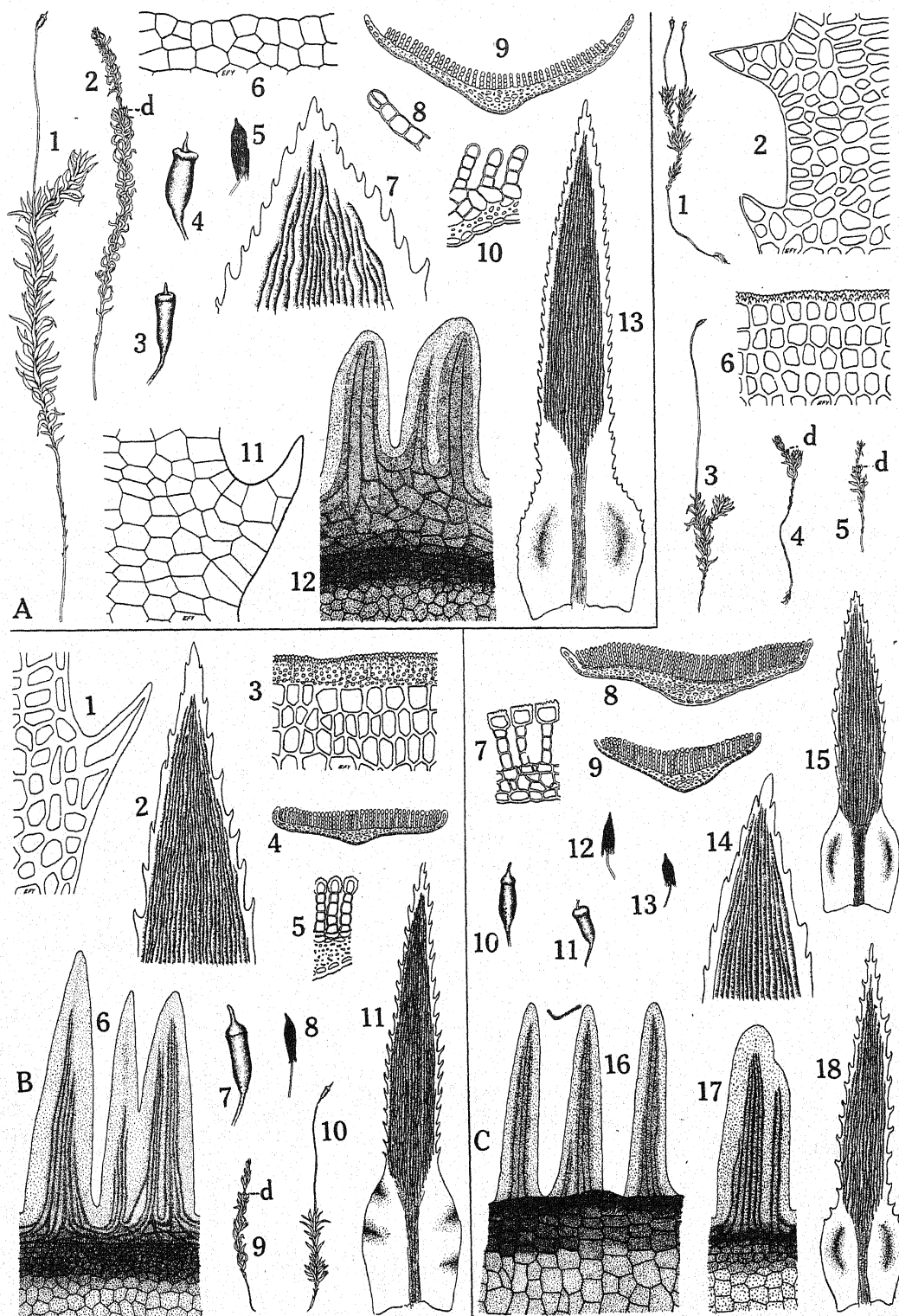


PLATE LIX.

PLATE 60. *Pogonatum alpinum* (1-4, 6-9, from Proc. Wash. Acad. Sci. 12: 302. f. 15). 1, leaf, $\times 12$; 2, leaf tip, $\times 45$; 3, dry plant, $\times 0.7$; 4, moist plant, $\times 0.7$; 5, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$; 6, cross section of a few lamellae showing thickened and papillose marginal cells, $\times 180$; 7, cross section of leaf, $\times 45$; 8, peristome, $\times 110$; 9, capsule, $\times 3.5$; 10, side view of lamella, $\times 267$; 11, side view of margin of lamella, $\times 800$.

12-14. *Pogonatum alpinum* var. *Mucounii* (13-14 from Proc. Wash. Acad. Sci. 12: 305. f. 16 in part). 12, dry plant, $\times 1$; 13, leaf, $\times 12$; 14, capsule, $\times 4$.

15-18. *Pogonatum alpinum* var. *arcticum* (15-18 from Proc. Wash. Acad. Sci. 12: 306. f. 17 in part). 15, leaf, $\times 12$; 16, dry plant with capsule, $\times 0.7$; 17, capsule, $\times 3.5$; 18, moist plant, $\times 0.7$.

19-22. *Pogonatum alpinum* var. *septentrionale* (19-21 from Proc. Wash. Acad. Sci. 12: 306. f. 17 in part). 19, leaf, $\times 12$; 20, dry plant, $\times 0.7$; 21, capsule, $\times 3.5$; 22, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$.

23-28. *Pogonatum alpinum* var. *brevifolium* (23-28 from Proc. Wash. Acad. Sci. 12: 306. f. 17 in part as var. *simplex*). 23, 24, leaves, $\times 12$; 25, 26, capsules, $\times 3.5$; 27, moist plant, $\times 0.7$; 28, dry plant with capsules, $\times 0.7$.

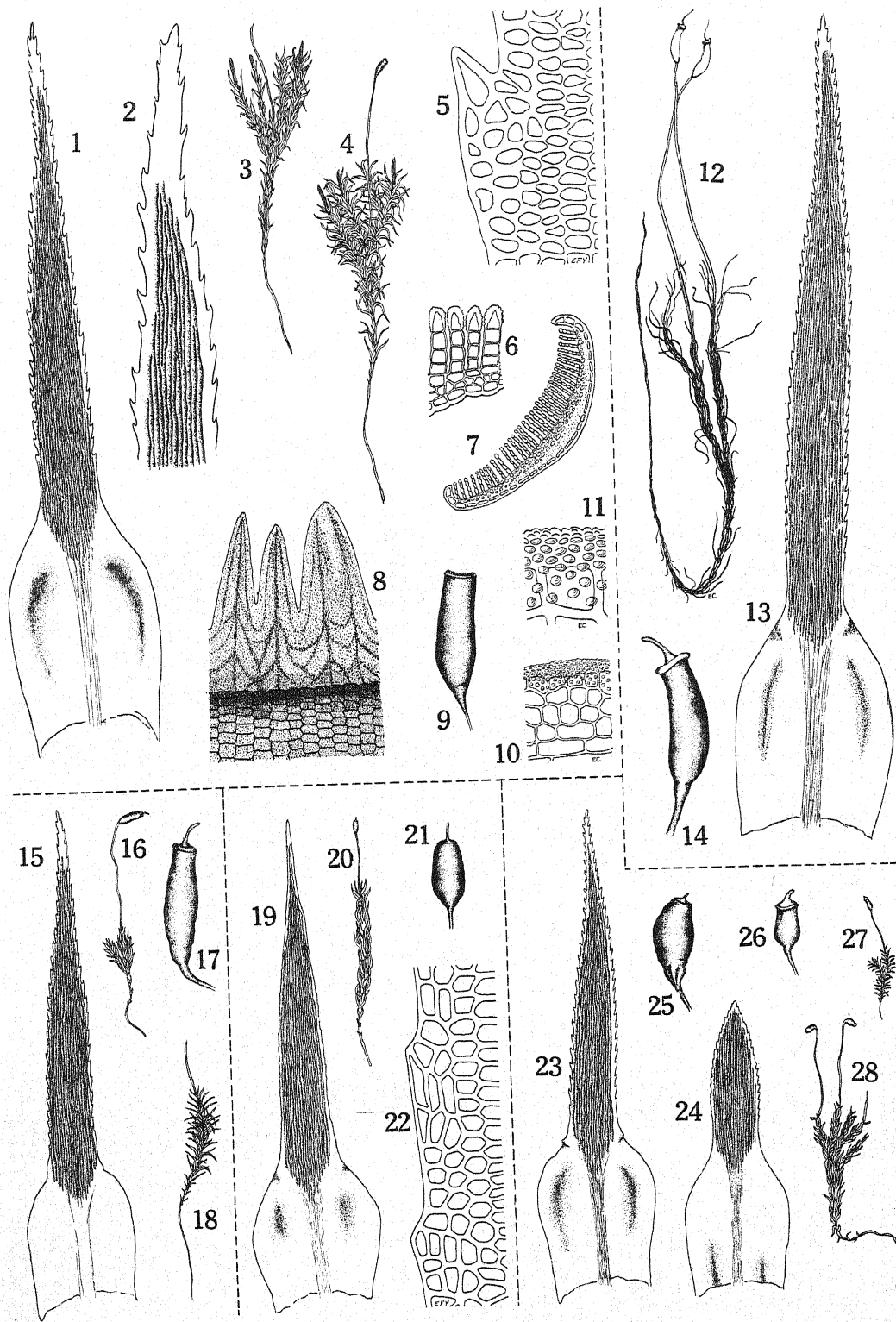


PLATE LX.

PLATE 61. A. *Polytrichum formosum* 1-2, 6-12 from Proc. Wash. Acad. Sci. 12: 311. f. 19 as *Polytrichum attenuatum*). 1, leaf, $\times 12$; 2, leaf tip, $\times 45$; 3, side view of lamella, $\times 250$; 4, epidermal cells of capsule without surface thin spots, $\times 250$; 5, cells of middle of leaf sheath at about $\frac{3}{4}$ distance from margin to costa, $\times 250$; 6, cross section of leaf, $\times 45$; 7, moist plant with capsule, $\times 0.7$; 8, dry plant, $\times 0.7$; 9, capsule, $\times 3.5$; 10, 11, cross sections of a few lamellae, $\times 180$; 12, peristome, $\times 110$; 13, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$.

B *Polytrichum gracile* (1-2, 6-11 from Proc. Wash. Acad. Sci. 12: 310. f. 18). 1, leaf, $\times 12$; 2, leaf tip, $\times 45$; 3, side view of lamella, $\times 250$; 4, marginal cells about $\frac{3}{4}$ up leaf, $\times 250$; 5, cells of middle of leaf sheath at about $\frac{3}{4}$ distance from margin to costa, $\times 250$; 6, moist plant with capsule, $\times 0.7$; 7, dry plant, $\times 0.7$; 8, capsule, $\times 3.5$; 9, cross section of leaf, $\times 120$; 10, cross section of a few lamellae, $\times 180$; 11, peristome, $\times 110$; 12, epidermal cells of capsule without surface thin spot, $\times 250$.

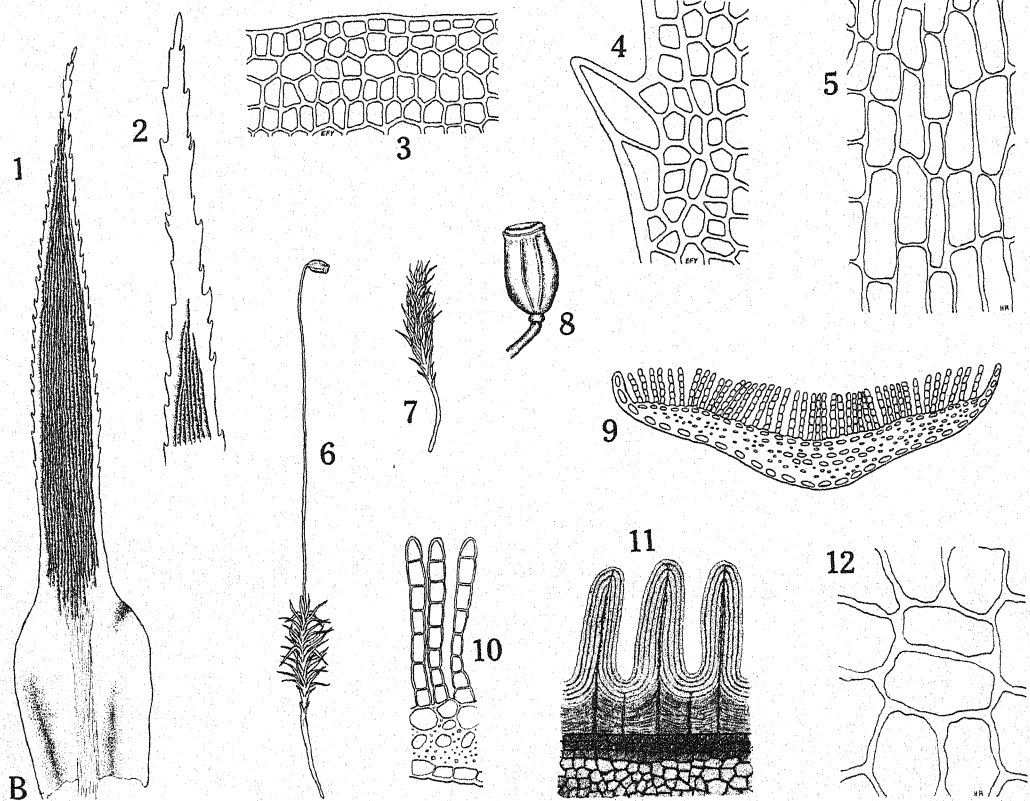
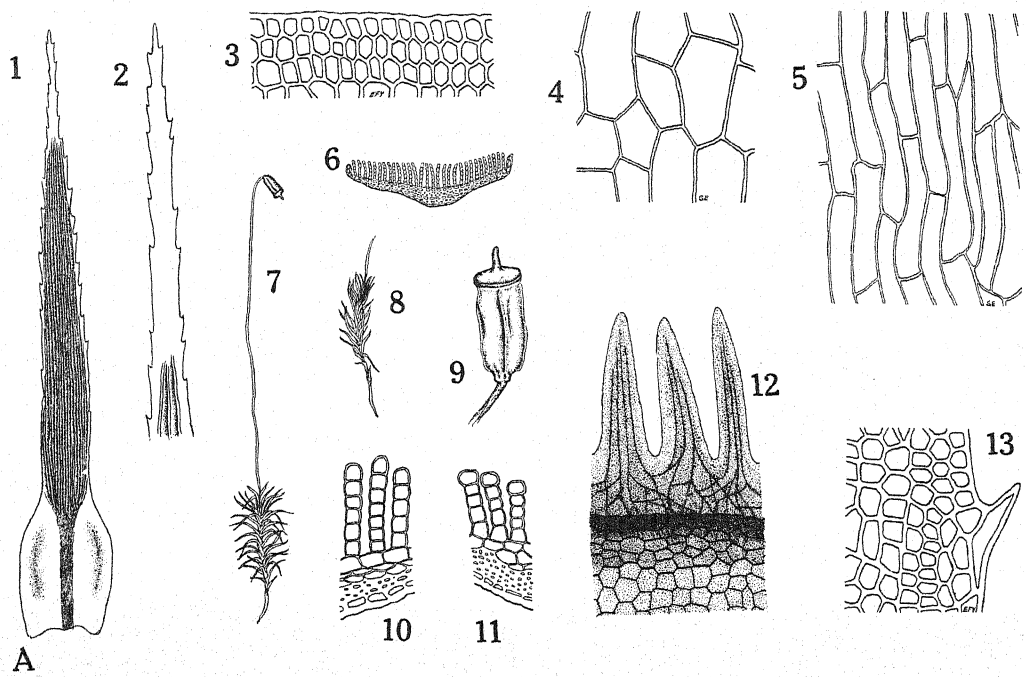


PLATE LXI.

PLATE 62. A. *Polytrichum ohioense* (1-2, 4-5, 7-12 from Proc. Wash. Acad. Sci. 12: 313. f. 20). 1, leaf, $\times 12$; 2, leaf tip, $\times 45$; 3, epidermal cells of capsule without surface thin spots, $\times 250$; 4, immature capsule covered by calyptra, $\times 3.5$; 5, capsule, $\times 3.5$; 6, side view of lamella, $\times 250$; 7, cross section of leaf, $\times 45$; 8, moist plant with capsule, $\times 0.7$; 9, dry plant, $\times 0.7$; 10, peristome, $\times 110$; 11, cross section of a few lamellae just above sheath, $\times 180$; 12, cross section of a few lamellae showing usual form of marginal cells, $\times 180$; 13, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$; 14, cells of middle of leaf sheath at about $\frac{2}{3}$ distance from margin to costa, $\times 250$.

B. *Polytrichum Swartzii* (1-2, 6, 8, 10 from Proc. Wash. Acad. Sci. 12: 314, f. 21 as *Polytrichum inconstans*). 1, leaf, $\times 12$; 2, leaf tip, $\times 45$; 3, epidermal cells of capsule with surface thin spots, $\times 250$; 4, capsule, $\times 10$; 5, calyptra, $\times 10$; 6, cross section of part of leaf, about $\times 45$; 7, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$; 8, dry plant, $\times 0.7$; 9, dry plant with capsule, $\times 0.5$; 10, moist antheridial plant, d , antheridial disk, $\times 0.7$; 11, side view of lamella, $\times 250$; 12, peristome, $\times 250$.

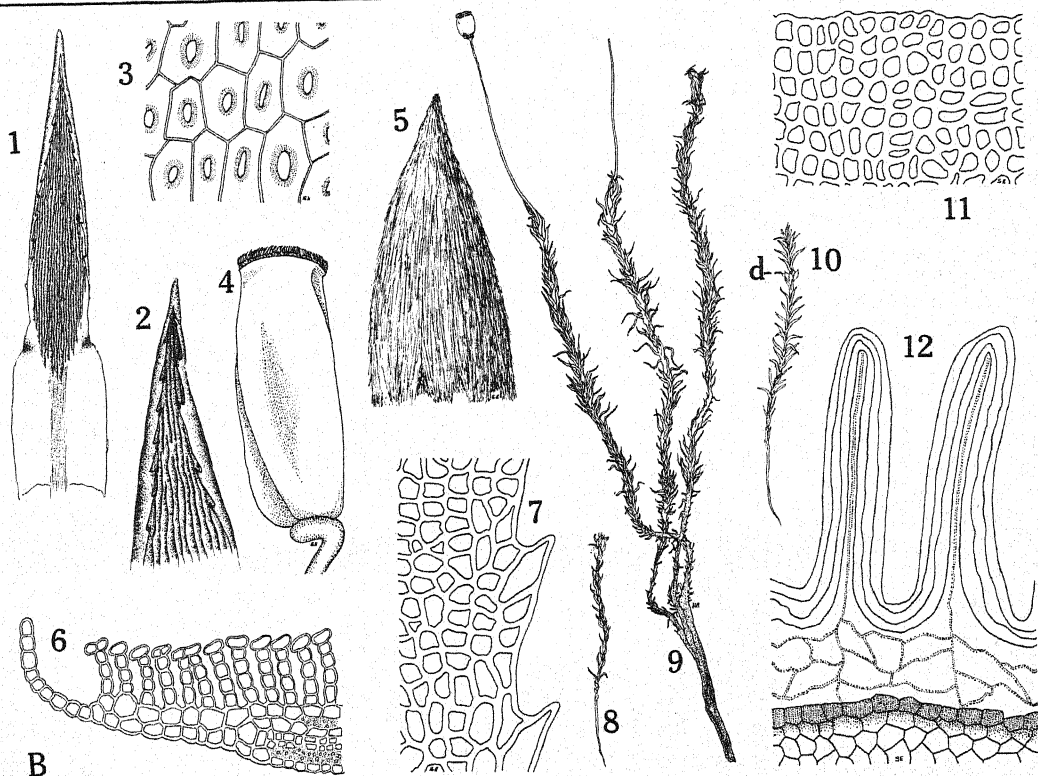
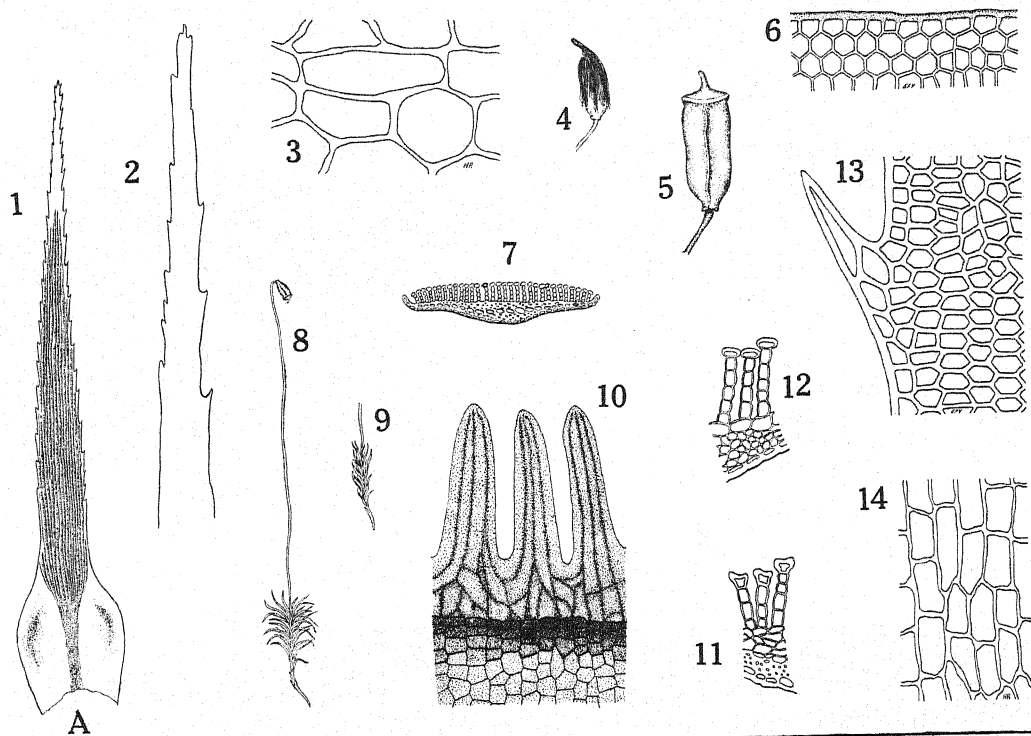


PLATE LXII

PLATE 63. *Polytrichum commune* (1-2, 5-13 from Proc. Wash. Acad. Sci. 12: 316-318. f. 22, 23, in part). 1, dry plant with capsule, $\times 0.7$; 2, dry antheridial plant, *d*, antheridial disk, $\times 0.7$; 3, side view of lamella, $\times 250$; 4, marginal cells about $\frac{3}{8}$ up leaf, $\times 250$; 5, peristome, $\times 110$; 6, leaf, $\times 12$; 7, leaf tip, $\times 45$; 8, cross section of leaf, $\times 45$; 9, immature capsule covered by calyptra, $\times 3.5$; 10, epidermal cells of capsule with surface thin spots, $\times 245$; 11, capsule, $\times 3.5$; 12, 13, cross sections of a few lamellae, showing notched marginal cells, $\times 180$.

14-19. *Polytrichum commune* var. *perigoniale* (15-18 from Proc. Wash. Acad. Sci. 12: 318. f. 23 in part). 14, side view of lamella, $\times 250$; 15, capsule, $\times 3.5$; 16, epidermal cells of capsule with surface thin spots, $\times 245$; 17, cross section of a few lamellae showing their height and the notched marginal cells, $\times 180$; 18, dry plant with capsule, $\times 0.7$; 19, marginal cells about $\frac{3}{8}$ up leaf, $\times 250$.

20-24. *Polytrichum commune* var. *Jensenii* (21-23 from Proc. Wash. Acad. Sci. 12: 319. f. 24 as *Polytrichum Jensenii*). 20, side view of lamella, $\times 250$; 21, moist plant, $\times 0.7$; 22, leaf tip, $\times 45$; 23, leaf, $\times 12$; 24, marginal cells about $\frac{3}{8}$ up leaf, $\times 250$.

25-30. *Polytrichum commune* var. *yukonense* (25 from Proc. Wash. Acad. Sci. 12: 320. f. 25 as *Polytrichum yukonense*). 25, plant, $\times 0.7$; 26, marginal cells about $\frac{3}{8}$ up leaf, $\times 250$; 27, side view of lamella, $\times 250$; 28, leaf, $\times 10$; 29, leaf tip, $\times 67$; 30, cross section of leaf showing notched marginal cells of lamella, $\times 67$.

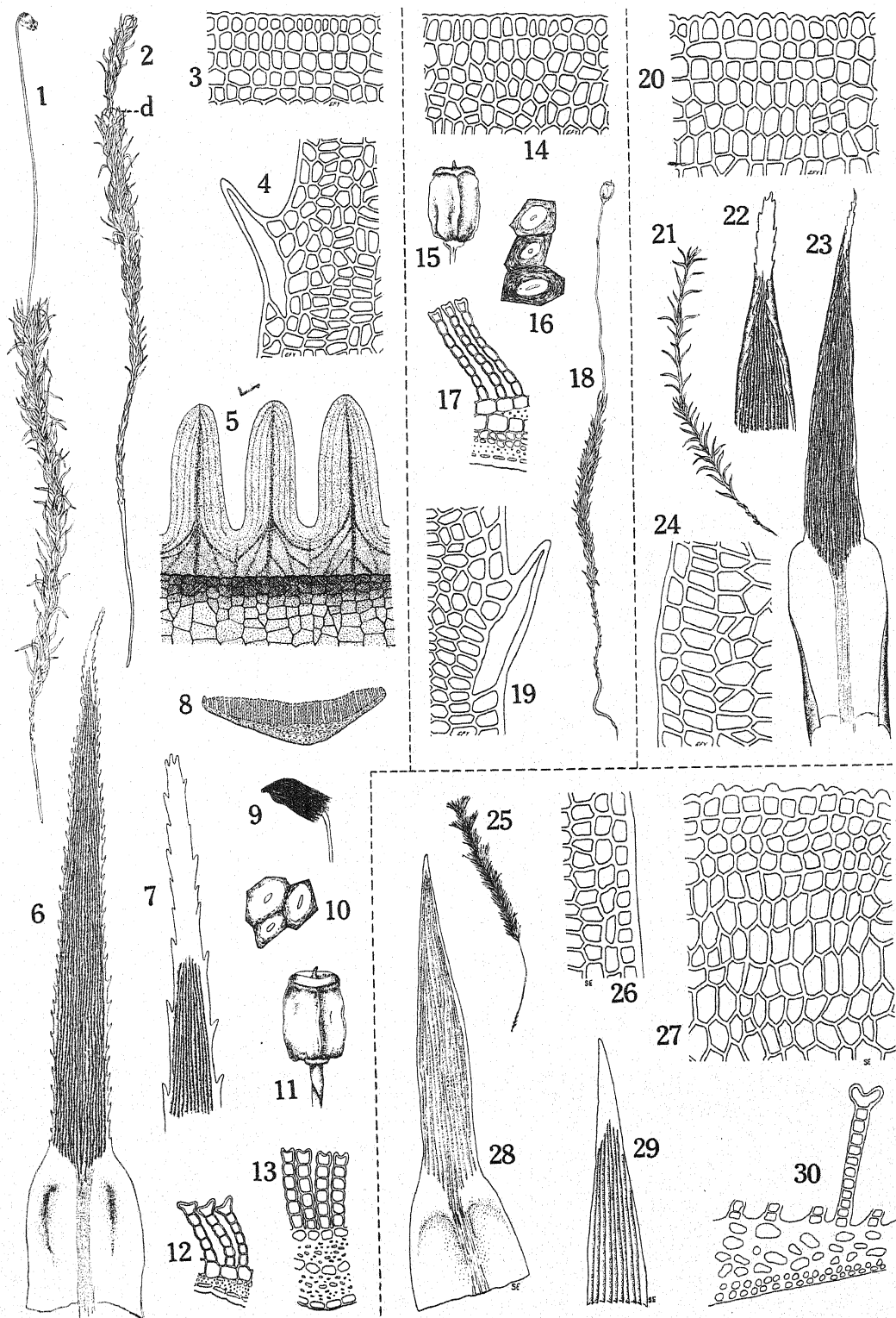


PLATE LXIII.

PLATE 64. A. *Polytrichum norvegicum* (1-2, 4-6, 8-11 from Proc. Wash. Acad. Sci. 12: 321. f. 26 as *P. sexangulare*). 1, moist plant, $\times 0.7$; 2, dry plant, $\times 0.7$; 3, side view of lamella, $\times 250$; 4, leaf tip, showing teeth at back, $\times 45$; 5, cross section of leaf, $\times 45$; 6, leaf, $\times 12$; 7, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$; 8, peristome, $\times 110$; 9, immature capsule covered by calyptra, $\times 3.5$; 10, capsule, $\times 3.5$; 11, cross section of a few lamellae, $\times 180$.

B. *Polytrichum juniperinum* (3-16 from Proc. Wash. Acad. Sci. 12: 323. f. 27 and 324. f. 28 as *P. strictum*). 1, side view of lamella, $\times 250$; 2, marginal cells about $\frac{2}{3}$ up leaf, $\times 250$; 3, moist antheridial plant, *d*, antheridial disk, $\times 0.7$; 4, cross section of leaf, $\times 45$; 5, dry plant with capsule, $\times 0.7$; 6, immature capsule covered by calyptra, $\times 3.5$; 7, capsule, $\times 3.5$; 8, cross section of a few lamellae, $\times 180$; 9, leaf, $\times 12$; 10, leaf tip, $\times 45$; 11, peristome, $\times 110$; 12, 13, capsules of var. *alpestre*, $\times 3.5$; 14, immature capsule of var. *alpestre* covered by calyptra, $\times 3.5$; 15, moist plant of var. *alpestre* with capsule, $\times 0.7$; 16, leaf of var. *alpestre*, $\times 12$.

C. *Polytrichum piliferum* (1-11, 14-15 from Proc. Wash. Acad. Sci. 12: 327. f. 30 and 326. f. 29 as *P. hyperboreum*). 1, leaf tip, $\times 45$; 2, leaf, $\times 12$; 3, moist plant with capsule, $\times 0.7$; 4, dry plant with capsule, $\times 0.7$; 5, 6, 7, capsules, $\times 3.5$; 8, immature capsule with calyptra, $\times 3.5$; 9, cross section of leaf, $\times 45$; 10, cross section of a few lamellae, $\times 180$; 11, peristome, $\times 110$; 12, side view of lamella, $\times 250$; 13, marginal cells about $\frac{2}{3}$ up, $\times 250$; 14, dry plant of var. *hyperboreum*, $\times 0.7$; 15, moist plant of var. *hyperboreum* with capsules, $\times 0.7$.

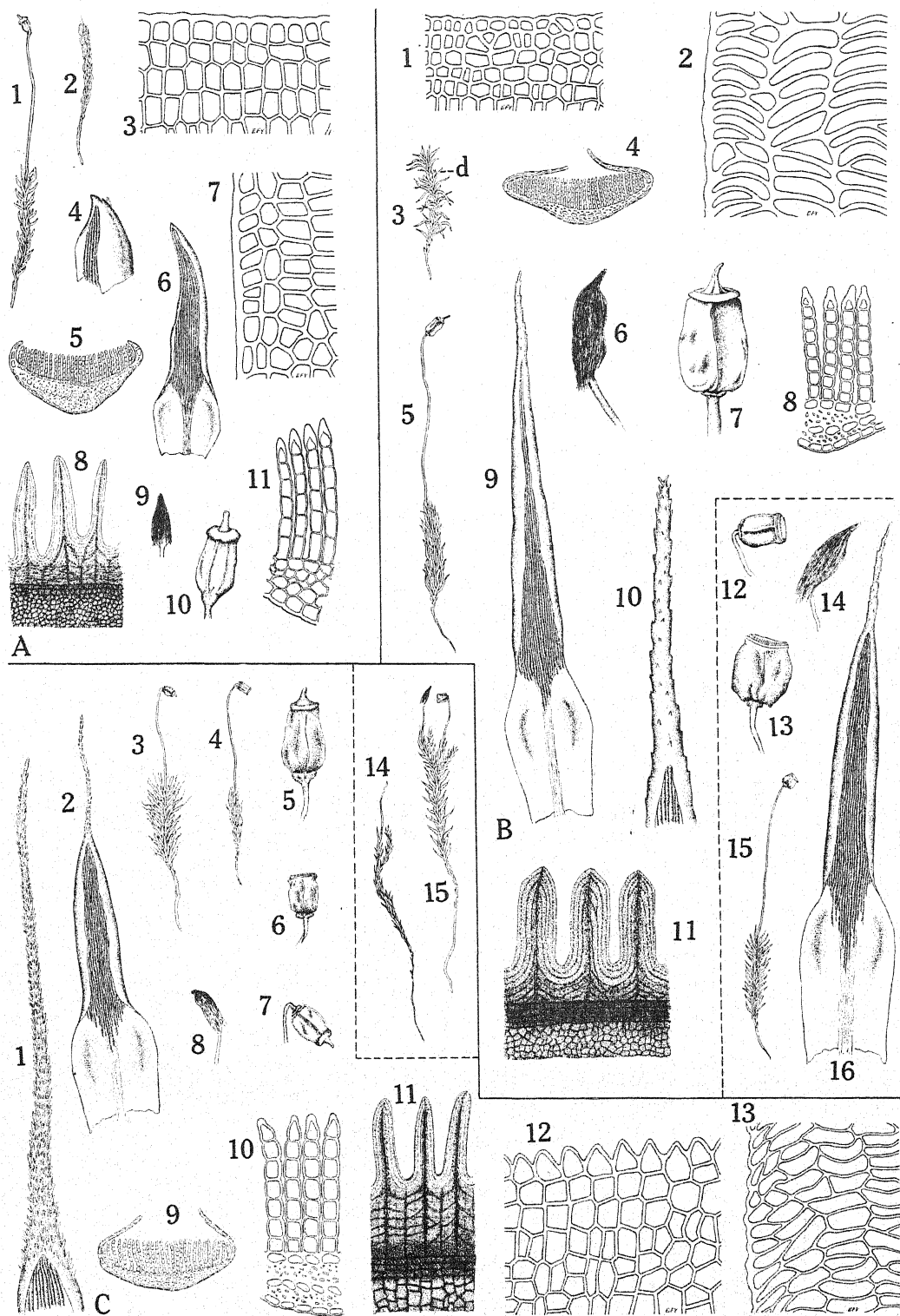


PLATE LXIV.

PLATE 65. *Syrrhopodon floridanus* (at right; from Sulliv., *Icones Musc.*, *pl.* 31). 2, fertile plant; 4, upper part of leaf; 5, 6, base of leaf showing papillose costa; 8, 9, capsules; 11, portion of peristome; 12, vertical section of peristome.

Syrrhopodon texanus (at left; from Sulliv., *Icones Musc. Suppl.*, *pl.* 20). 2, fertile plant; 3, stem leaf; 5, leaf-apex; 6, leaf-base; 7, cross-sections of leaf; brood body from end of costa; 12-15, operculum and calyptra; 16, 17, detail of peristome.

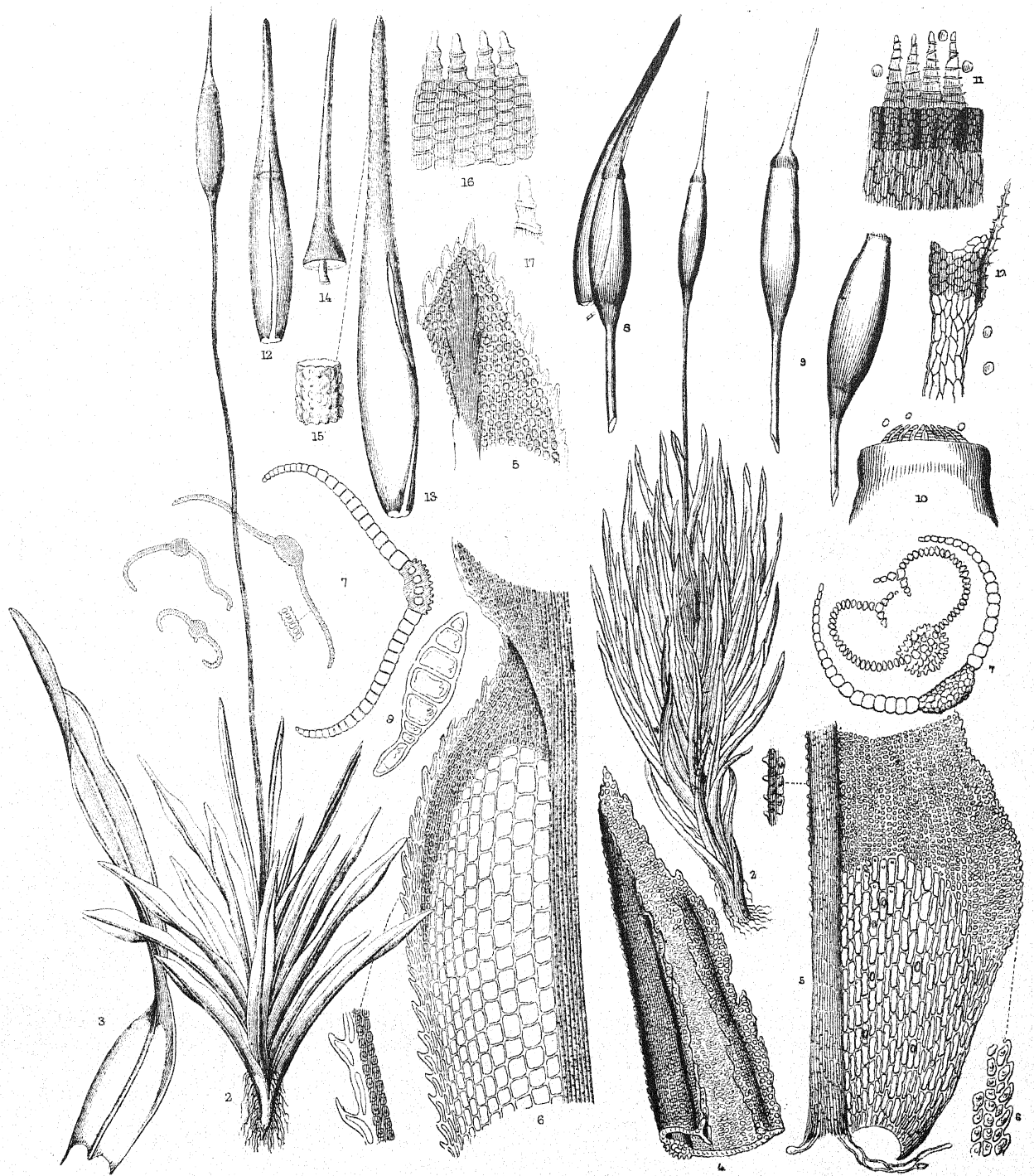


PLATE LXV.

PLATE 66. 1 and 2, *Syrrhopodon incompletus*. Leaves, $\times 20$.
3-7, *Syrrhopodon ligulatus*. 3, 4, 5, leaves, $\times 40$; 6, leaf-apex showing gemmae, $\times 80$; 7, dorsal view of leaf apex, $\times 80$.
8. *Syrrhopodon parasiticus*. Cluster of mature sporophytes, $\times 10$.
9-14, *Syrrhopodon filigerus*. 9, apical, propaguliferous leaf, $\times 27$; 10, 11, leaves, $\times 27$; 12, areolation of upper leaf-margin, $\times 375$; 13, nearly mature sporophyte, $\times 10$; 14, mature sporophyte with deoperculate capsule, $\times 10$.
A. *Syrrhopodon parasiticus* (from Williams, Bryol. 26: 46). 1, plant, $\times 1$; 2, 3, 4, apical stem leaves, $\times 20$; 5, leaf from a little below the apex, $\times 20$; 6, leaf-apex, $\times 275$; 7, areolation at leaf-margin; 8, cross-section of leaf, $\times 275$; 9, propagulum, $\times 60$.

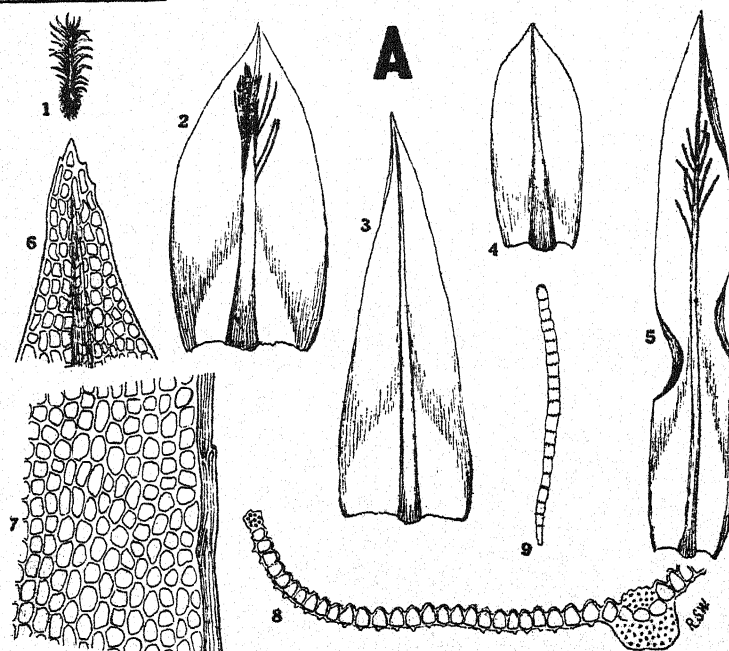
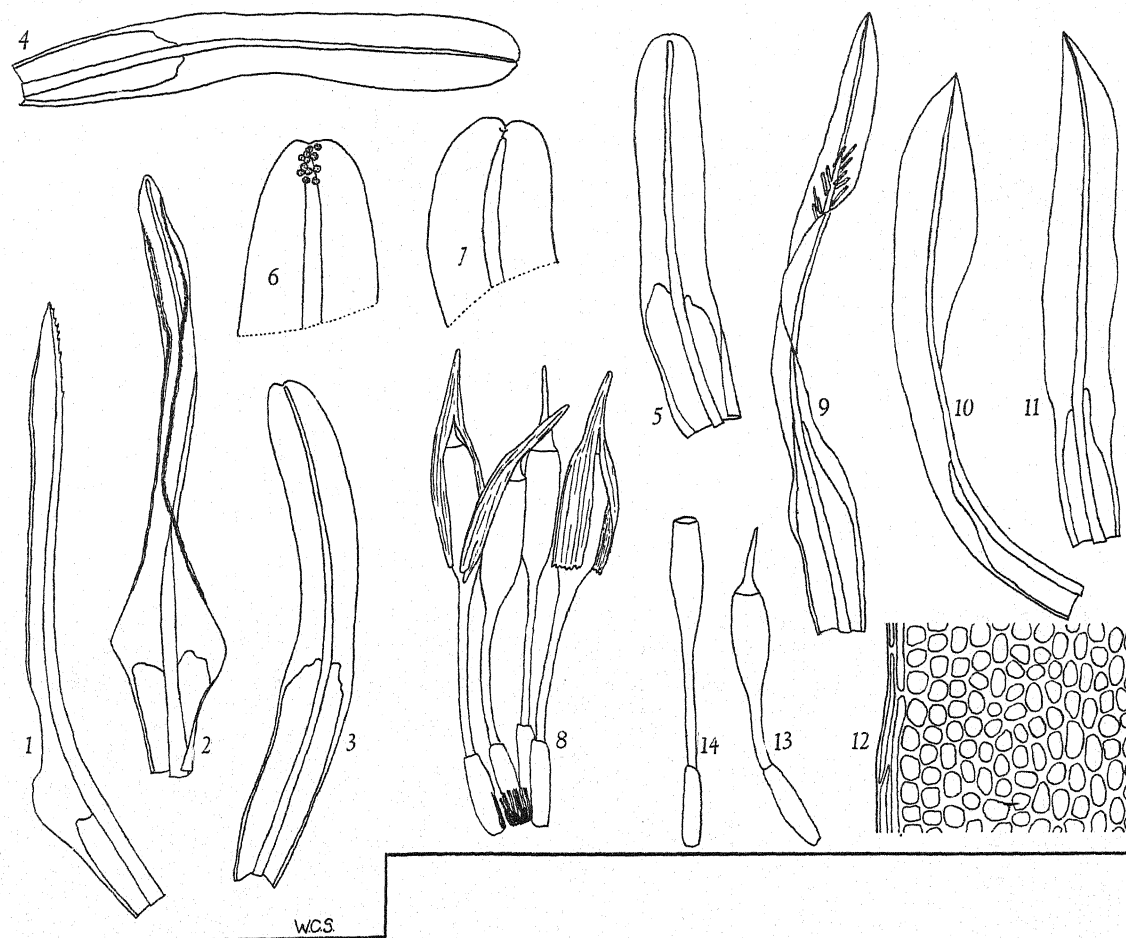


PLATE LXVI.

PLATE 67. 1-5, *Calymperes Nashii*. 1, apical leaf bearing propagula, $\times 40$; 2, propagula, enlarged, $\times 80$; 3, 4, lower leaves, $\times 40$; 5, areolation of upper leaf-base, $\times 375$.

6-11, *Calymperes Richardi*. 6, 7, lower leaves, $\times 40$; 8, 9, upper propaguliferous leaves, $\times 40$; 10, areolation of upper leaf-base, $\times 375$; 11, areolation of upper leaf-margin, $\times 375$.

12-16, *Calymperes emersum*. 12, 13, 14, leaves, $\times 25$; 15, areolation of upper leaf-base, $\times 375$; 16, areolation of upper leaf-margin, $\times 375$.

17-19, *Calymperes Donnellii*. 17, 18, leaves which will bear propagula, $\times 25$; 19, areolation of upper leaf-base, $\times 375$.

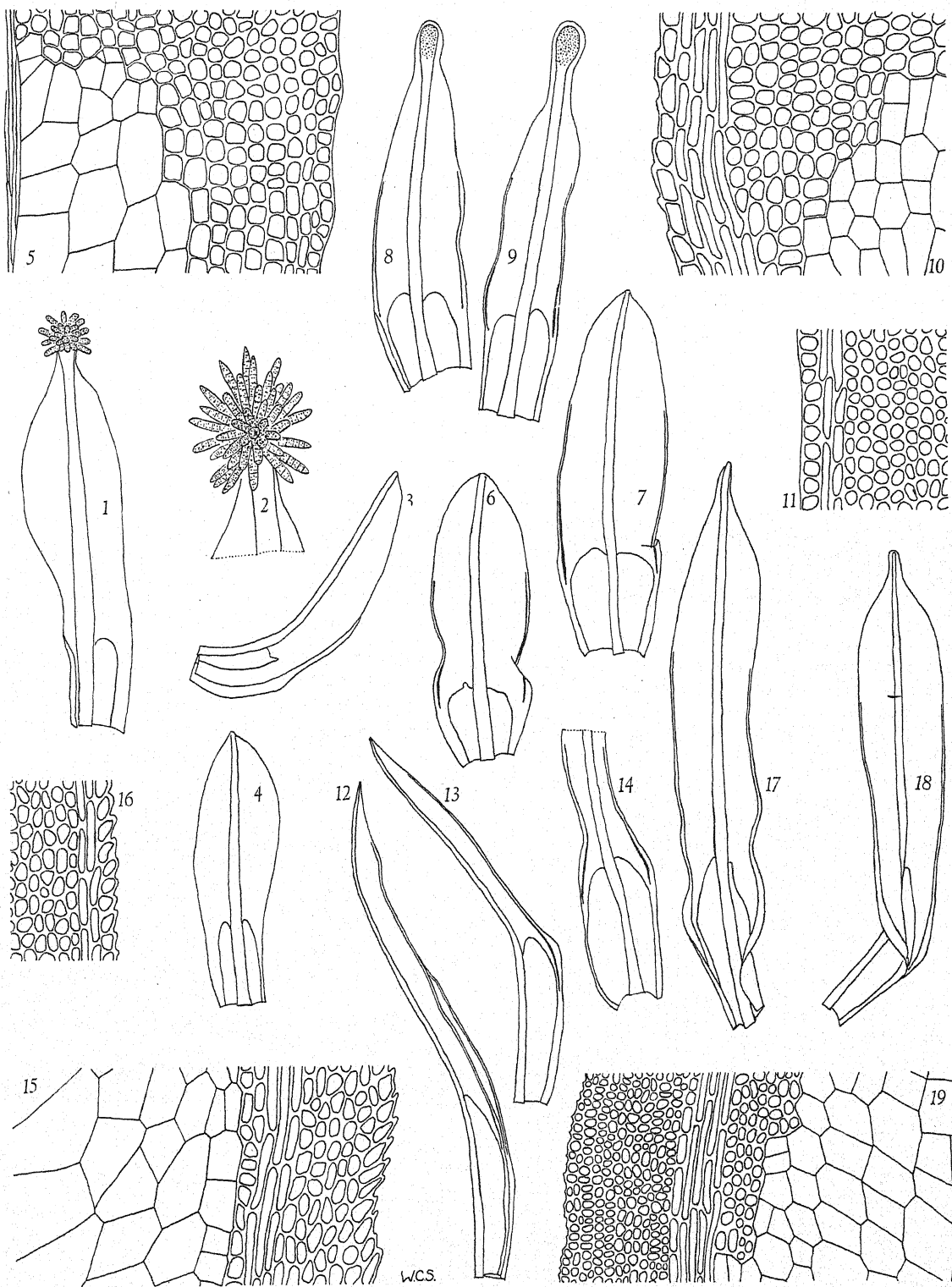
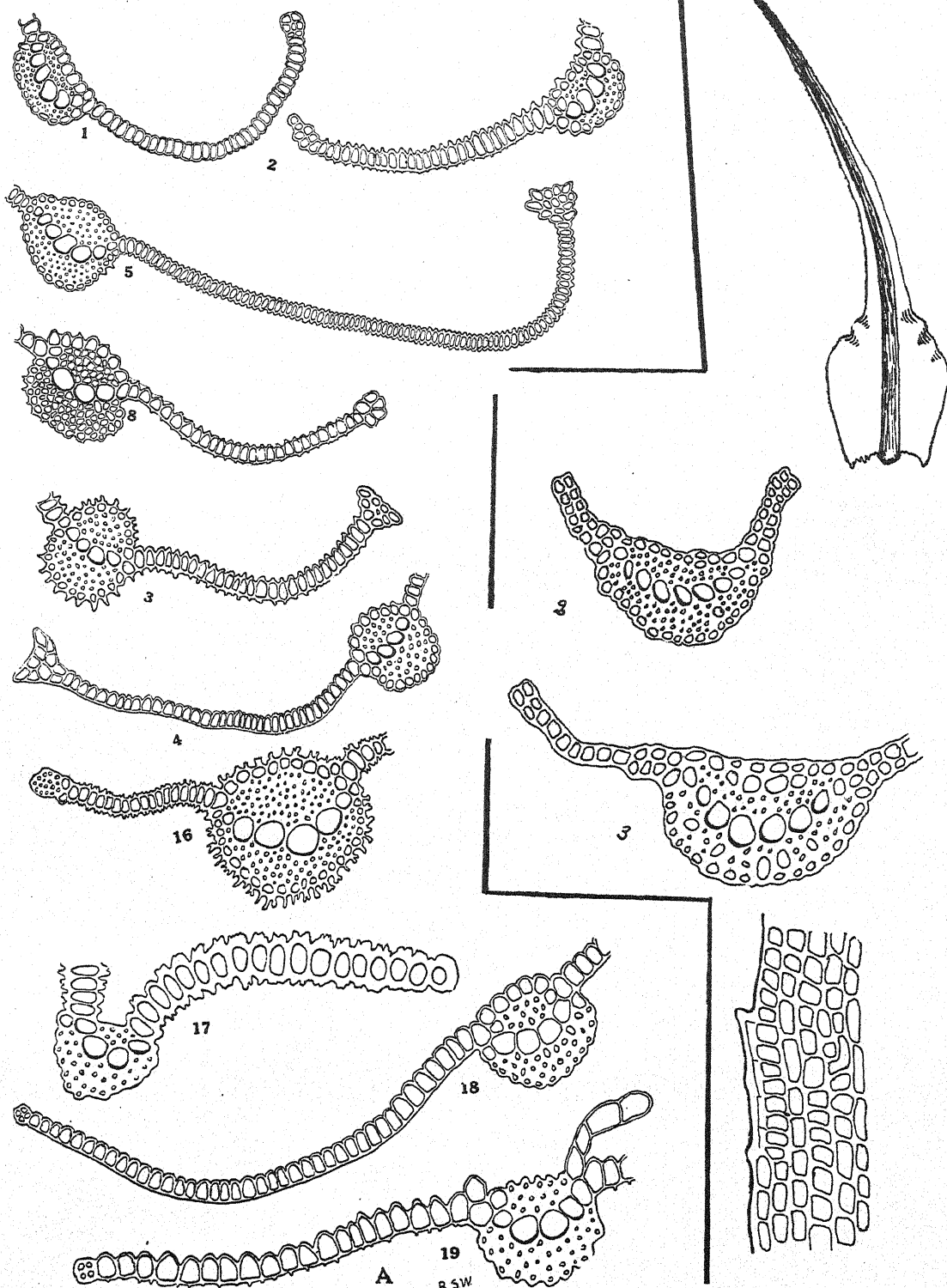


PLATE LXVII.

PLATE 68. A. *Calymperaceae*. (Cross sections of leaves about midway; from Bull. Torr. Club. 47: plates 15-17.) 1, *Calymperes Richardi*, $\times 200$; 2, *C. emersum*, $\times 300$; 5, *C. Donnellii*, $\times 300$; 8, *C. Nashii*, $\times 300$.

3, *Syrrhopodon floridanus*, $\times 235$; 7, *S. incompletus*, $\times 235$; 16, *S. texanus*, $\times 235$; 17, *S. ligulatus*, $\times 350$; 18, *S. parasiticus*, $\times 350$; 19, *S. fligerus*, $\times 350$.

B. *Oncophorus Rauei* (from Bryologist 14: 70). 1, median leaf-cells, $\times 270$; 2, 3, cross sections of leaf, $\times 270$; 4, upper stem leaf, $\times 16$.



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PLATE LXVIII.

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